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Education and the Federal Laboratories

An assessment of Federal laboratory educational activities and their present and potential relationships with universities.

FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY
Committee on Federal Laboratories
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FOREWORD

"A strong and vital educational system is an essential part of the Great Society. In building our national educational system, we must bear in mind all of the parts, and all of the levels -- from Headstart for pre-school children to the most advanced university levels. At the apex of this educational pyramid, resting on the essential foundation provided for the lower levels, is the vital top segment where education and research become inseparable. The Federal Government has supported academic research in agriculture for over a half century and in the physical sciences, life sciences and engineering since World War II; the returns on this national investment have been immense . . . .

"The strength of the research and development programs of the major agencies, and hence their ability to meet national needs, depends heavily upon the total strength of our university system. Research supported to further agency missions should be administered not only with a view to producing specific results, but also with a view to strengthening academic institutions and increasing the number of institutions capable of performing research of high quality."[1]

/s/ Lyndon B. Johnson

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[1] From "Strengthening Academic Capability for Science Throughout the Country," Memorandum to the Heads of Departments and Agencies, September 13, 1965.

SUMMARY OF RECOMMENDATIONS

The laboratories owned and operated by the United States Government are rich in talent and equipment. Their primary task is to carry on scientific investigations in support of the missions of the departments of which they are a part. However, the laboratories can and often do establish relationships with colleges and universities which are beneficial to both parties. During 1966 and 1967 the Federal Council for Science and Technology initiated and carried out an interagency study of the existing degree and nature of Federal laboratory-university collaboration, obstacles to further collaboration and means of extending such collaboration.

The results of the Federal Council study led to the conclusion that the maintenance of a high level of competence and effectiveness in Federal laboratories requires a strong program for the continuing education and professional development of the technical staffs of the laboratories which can probably best be brought about through cooperative arrangements with available universities. It is also evident that Federal laboratories frequently possess special skills and unique or unusual facilities which can contribute effectively towards meeting the total educational needs of the Nation through cooperative arrangements with universities. The national effort to expand graduate education resources should take explicitly into account the potentialities of the Federal laboratories. Federal laboratories need the invigorating influence of graduate students and faculty members from colleges and universities.

As a means of meeting these objectives, nine recommendations are suggested by the study. The recommendations are as follows:

RECOMMENDATION NO. 1: As a matter of policy, Federal organizations should take the initiative, where feasible and suitably related to the agency mission, in establishing joint activities with universities, such as joint research projects and training centers, as a desirable way to foster relationships which aid educational and training activities. (p. 8)

RECOMMENDATION NO. 2: In recognition that the establishment and operation of dynamic training programs is an essential requirement of laboratory leadership, departments and agencies should (1) fully publicize the many benefits and educational opportunities available under the Government Employees' Training Act; (2) provide positive support for making optimum use of these in the form of budgetary and staff ceiling allowances; (3) encourage field laboratories to develop training programs in cooperation with other nearby laboratories; (4) delegate to the maximum extent possible authority to heads of R&D laboratories for approving training; and (5) otherwise streamline procedures essential to the optimal utilization of the Government Employees' Training Act. (p. 12)

RECOMMENDATION NO. 3: The Office of Science and Technology should request the American Council on Education to participate with Federal representatives in studying ways of improving university–Government cooperation in education and training programs of mutual interest, including an evaluation of the conditions causing university withdrawal from some laboratory educational activities. (p. 16)

RECOMMENDATION NO. 4: In accordance with the intent of the President's memorandum "Strengthening Academic Capability for Science Throughout the Country," departments and agencies should issue policy guidelines for the development of specific programs to improve Federal laboratory–university relationships. (p. 19)

RECOMMENDATION NO. 5: Laboratory managers should make more extensive use of flexible procedures, particularly WAE appointments, to promote the interaction of university personnel with the regular full–time professional staff; manpower ceilings should recognize the need for such appointments. (p. 22)

RECOMMENDATION NO. 6: The executive branch should vigorously support legislation authorizing a Government–wide program for visiting scientists and engineers. It is essential that any new program incorporate provisions that make such appointments as far as possible on a "no loss" basis, and that remove many of the present deterrents to effective interchange with universities and other organizations. (p. 27)

RECOMMENDATION NO. 7: Departments and agencies should encourage laboratories to make greater use of change of duty stations to facilitate the flow of Federal scientists and engineers into other research centers for limited periods. (p. 28)

RECOMMENDATION NO. 8: The Office of Science and Technology is urged to promote full understanding by top administrative officials as to the vital necessity of maintaining scientific interchange through attending professional meetings, with a view toward obtaining a realistic appreciation of the essential nature of these activities. (p. 30)

RECOMMENDATION NO. 9: The Office of Science and Technology is urged to initiate the endorsement, clearance and issuance of the following Government–wide policy:

> *Unique, unusual, and expensive–to–duplicate facilities at Federal laboratories and federally–supported research centers should be made available to the national scientific community to the maximum extent practical without serious detriment to laboratory missions, especially to qualified academic scientists and engineers who would otherwise not have access to such facilities. Criteria for such use should be the scientific merit of the proposed experiment, its relations to the agency research mission, and its contribution to related national educational needs.*

When such facilities are used by academic scientists and engineers, the costs incurred by the laboratory or center for the operation of its unique or unusual research facilities should generally be funded by the agency responsible for the operation of that facility, except for any significant incremental costs incurred in support of research not directly related to the agency's mission. The research costs incurred at the experimenter's home institution and significant costs for specialized equipment fabricated at the center primarily for use by the particular experimenter should normally be borne by the granting agency, the home institution, and/or other sponsoring organization, but may, when deemed sufficiently related or useful to the host agency's responsibility, be borne by the agency responsible for operation of the center. (p. 34)

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INTRODUCTION

In response to a request from the Federal Council for Science and Technology, the Standing Committee (subsequently renamed the Committee on Federal Laboratories) undertook a study relating to the use of Federal research and development (R&D) facilities for advanced education and training:

1. To determine how well Federal laboratories are doing in continuing educational efforts;

2. To make recommendations for improvements; and

3. To explore the potential of Federal agencies in contributing more broadly to the educational activities of the Nation.

The principal requirements for the study were knowledge of the types of relationships between Federal laboratories and universities through the interchange of ideas, identification of successful experiences, and definition of the major impediments to more meaningful relations. A preliminary test of a special questionnaire in 14 laboratories revealed that the most meaningful information was contained in narrative comments that supplemented the structured questions. The narrative information identified special relationships and problems peculiar to the local environment that could not be obtained by predetermined questions. As a result of the experience the decision was made to conduct the study through on-site interviews at the Federal R&D laboratories. Accordingly, a task force was appointed to interview a representative number of laboratory managers and their staffs. This report is based largely on the results of these discussions and other information from 75 Federal research and development installations.[1]

PLAN OF THE STUDY

OPERATING DEFINITIONS

Such terms as basic research, applied research, development, testing and evaluation are used throughout this report to describe a continuum proceeding from ideas through concepts to actual practical accomplishment. Although the report is concerned with activities at all points along this continuum, primary emphasis has been placed on organizations nearer the research end in the belief that more varied educational activities would be found in those organizations.

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[1] The Task Force also visited one Federal Contract Research Center, the National Center for Atmospheric Research, at Boulder, Colorado.

The words "education" and "training" are used synonymously. In actual practice many (often conflicting) distinctions are made between the two terms. It was felt that adoption of arbitrary definitions for these activities would serve no constructive purpose. Similarly, the word "university" is used generally in this report to include all academic institutions of higher education.

Definition of "laboratory" presented a problem. A popular concept of a laboratory as a place enclosed by four walls and populated with men in white coats was obviously too narrow and restrictive for such fields as astronomy, forestry, geology and oceanography, where nature provides the setting for scientific inquiry. Therefore, the term "laboratory" in this report includes any research and development installation in which there are, with a few exceptions, 50 or more federally-employed scientists or engineers engaged in R&D work and physically assembled in one location. The numerical criterion excluded from this study hundreds of smaller installations. Moreover, various laboratories operated by non-Federal contractors, such as AEC installations and the Jet Propulsion Laboratory, were excluded. Extensive or fully representative coverage may not have been obtained for some departments and agencies as a result.

LABORATORY SAMPLE

A previous report of the Federal Council prepared by the Standing Committee (The Environment for Quality, April 1966) pointed out the heterogeneous nature of Federal R&D installations in terms of different attitudes of scientists and engineers according to a number of factors --discipline, agency, size and location of laboratory, educational level, years of experience, nature of work, grade level and salary. Insofar as possible, selection of laboratories to visit was based on such factors, in an effort to obtain a reasonably representative sample of the many diverse activities and attitudes involved in Federal R&D efforts. Situations were also identified where laboratory-university relationships appeared to be significantly different, and these were included in order to permit exploration of factors which link or fail to link the academic community and the Federal R&D community. In addition, in several metropolitan areas all Federal laboratories in the area were interviewed, regardless of the size of the laboratory.

The resulting sample includes a number of Federal laboratories with quite different characteristics, some prestigious, others comparatively obscure. The variety was so great as to preclude detailed statistical analysis of the data, partly because of the unreliability of small numbers. Therefore, statistical analysis was rather gross and based on the laboratory as a unit; there was no weighting according to the number of employees or the size of the budget. About 40 percent of all Federal installations meeting the operating definition of "laboratory" were interviewed by task force members. The list of laboratories visited is contained in Appendix A.

LABORATORY INTERVIEWS

At most of the 76 laboratories visited, a three-man team from the task force conducted interviews with laboratory management (scientific directors, administrators, scientist and engineer division and/or laboratory chiefs, personnel and training officers) in one or more individual or group meetings. Since it was most important that a congenial atmosphere prevail--to encourage frank and open exchange of information and opinions--a non-directive conversational form of interview was conducted, using only a few general introductory questions. A few specific questions usually were necessary near the end of the interview, to insure complete coverage.

In nearly all laboratories a free-wheeling interchange occurred during which numerous topics were discussed without apparent reservation. The laboratory managers were frank and helpful, occasionally volunteering information that does not normally reach their own headquarters, and often expressing both appreciation and considerable interest in the task force assignment. It would have been impossible to obtain such information and opinions from questionnaires.

METHODS OF ANALYSIS

Extensive notes made during and after the interviews formed the major basis for qualitative analysis. For each major subject, laboratories were grouped according to the nature and extent of their activities and analyzed along six dimensions: (1) agency, (2) size of laboratory, (3) nature of work, (4) geographical location, (5) academic environment, and (6) "clustering"--a complex of laboratories located together under a single department, (as at Wright-Patterson Air Force Base); or under different departments but sharing similar scientific or engineering goals, (as the Army and NASA units at Huntsville, Alabama).

Important differences were found and are discussed in the following sections of this report. (Detailed results of the cross-analysis between the six dimensions and the major subjects are contained in Appendix C.) Charts appearing in this report have been abstracted from tables containing full data for each dimension. In each chart the proportion of laboratories which have extensive and effective activities (or which have little or no activities) are shown for each of the above six dimensions. The laboratories constituting the middle--or "average"--group are not shown on the chart, but are included in the full tables in Appendix C.

Additional information on methodology of the study and characteristics of the laboratory sample are included in Appendix B.

UNIVERSITY-LABORATORY RELATIONSHIPS

The key to more extensive and effective use of Federal R&D facilities in advanced education and training clearly lies in the area of laboratory-university relationships. The laboratories are limited in what they can do alone, either through budget and personnel restrictions or through laws and matters of public policy. Universities face similar problems. Often the two can combine their interests and resources to accomplish far more than either could alone. In a number of cases Federal installations contain relatively unique research facilities that would be very helpful to scientists from other institutions. Whether the many potential combinations of interests and resources take place depends largely on the nature, variety and strength of laboratory-university relationships.

Many tangible benefits resulting from good university-laboratory relationships have been identified--some benefiting the laboratory, some the university, and some science and engineering in general. From the viewpoint of the Federal laboratory, however, one of the strongest endorsements derives from a quite intangible element--the atmosphere in those laboratories which enjoy close working relationships with universities. In talking with persons in these laboratories, one senses a purpose, an alertness, an enthusiasm, a striving for excellence, a dedication, a feeling of accomplishment coupled with unlimited potential contribution, a vibrant participation at the advancing frontiers of science, an excitement, a sense of life and involvement. This atmosphere, fostered by close association with the academic world, highly desirable and not easily attained, was seldom transmitted to the task force in laboratories lacking close university relationships. It seems clear that a close working relationship with universities is a definite plus to a Federal R&D laboratory.

Nearly a third (22) of the laboratories visited had unusually excellent relations with one or more universities and impressed the task force as being progressive and dynamic on the basis of objective evidence. Sixteen were heavily research oriented, the remaining six were oriented toward both research and development, and none was primarily concerned with development, testing or evaluation. Four factors seem to account for this pattern: (1) The work done in research-oriented laboratories is similar to that done in universities, making work-related activities a natural area for cooperation. (2) A high proportion of the staff of research-oriented laboratories have doctoral degrees, value the academic atmosphere, and tend to identify with universities. (3) R&D-oriented laboratories have enough research work and staff with doctoral degrees to appreciate the value of advanced education, and so tend to upgrade the academic attainment of professionals who are hired at the master and bachelor levels. (4) Laboratories oriented toward development, testing and evaluation appear to be highly "mission" and "production" centered; apparently they often feel neither the need for nor the desirability of university association or advanced education of their professional staff when these conflict with "getting the job done."

Effective university relationships are much more prevalent where Federal R&D laboratories are located in "rich" or "close" academic areas, defined as communities where mutuality of interest exists between the Federal installations and one or more academic institutions. Laboratories located in areas where there are a few or no other Federal laboratories engaged in similar work tend to have more effective university relationships than laboratories located as part of a cluster of similar laboratories. Little difference was found between DOD laboratories and non-DOD laboratories; each constitutes half of the task force sample. Chart 1 indicates differences in university relationships according to the six dimensions.

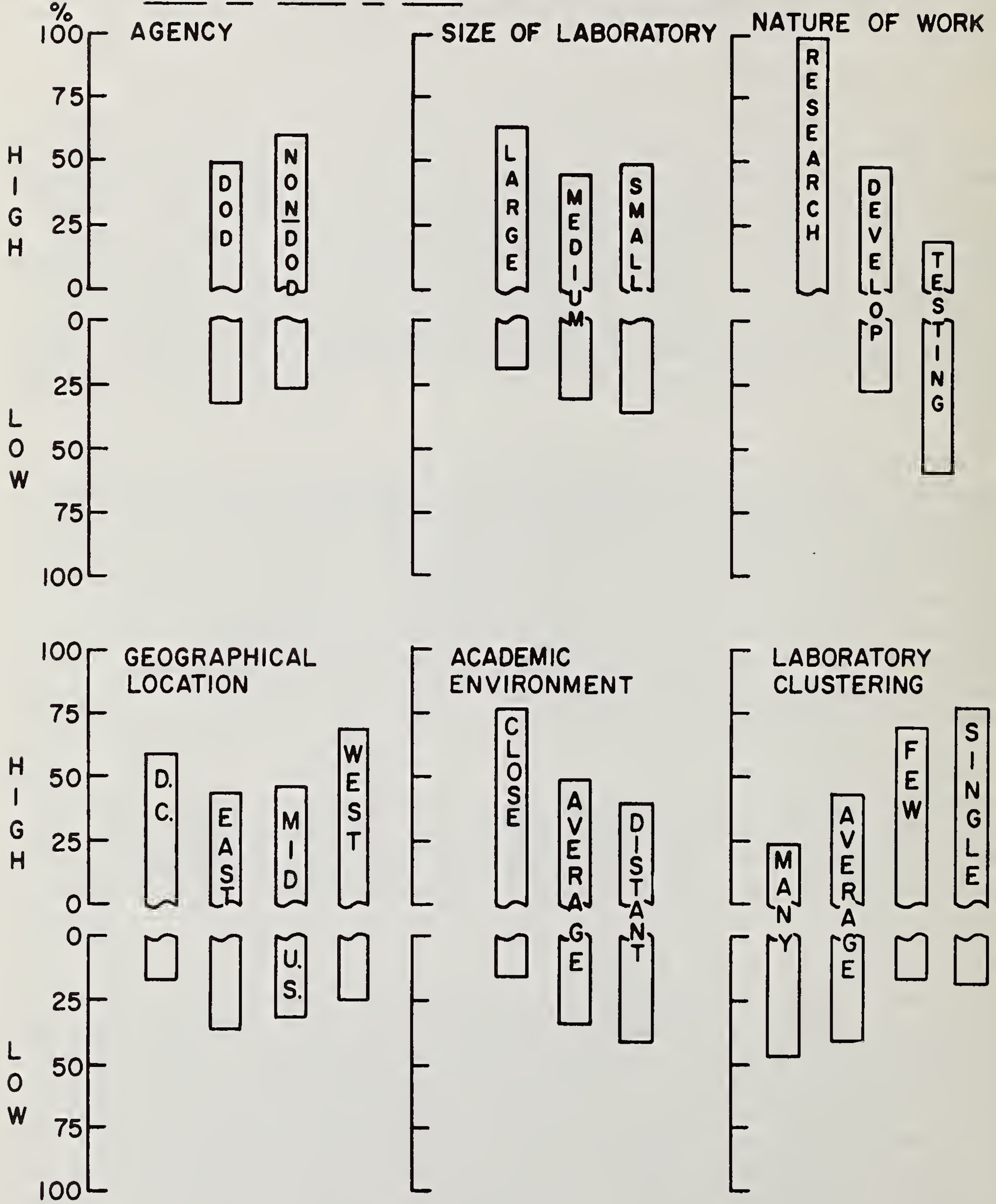
Why do Federal laboratories engage in educational and training activities involving Federal employees and outsiders? The most important reason, cited by nearly 90 percent of the laboratories, is to update the skills and generally increase the competence of the laboratory's professional staff--"to stay competitive," as one laboratory director phrased it. In view of the increasing complexity and rapid development of science and technology, laboratory management feels strongly that it must engage in education and training activities in order to maintain a dynamic organization. As a close concomitant, about a fifth of the laboratories also indicated "to get the work done" as a reason for training.

Ranking second in importance, cited by 60 percent of the laboratories, education and training programs are viewed as a recruitment aid. Laboratory managers believe these programs, directly and indirectly, help to alleviate problems in attracting and retaining a competent professional staff. Allied with this is the benefit of maintaining interest and high morale.

These two major reasons, clearly in the individual laboratory's immediate self-interest, are focused inwardly; that is, they improve the laboratory's position directly and aid in accomplishing its specific work-related goals. Another motivation of about a third of the laboratories is focused outwardly, encompassing broader and longer-range approaches that are directed primarily toward and provide benefit to institutions and people outside the laboratory. These include the improvement of university-laboratory communication and relations, filling academic curriculum gaps, and general advancement of the sciences in the laboratory's particular fields of interest. The resulting

CHART I - UNIVERSITY RELATIONSHIPS

Percent of laboratories ranked high (extensive and effective university relationships) or low (neutral or little; no significant input). Middle group not shown on chart.



benefits to the laboratory may sometimes be deferred and intangible but the ultimate effects are substantial and, in essence, represent investments in the future. These investments provide for self-renewal of the organization which must cope with increasingly complex problems as immediate tasks are accomplished and science advances.

FORMS OF UNIVERSITY-LABORATORY RELATIONSHIPS

These relationships take any or all of three forms: (1) work-oriented activities, (2) education of laboratory employees, and (3) education of those who are not laboratory employees.

1. Work-Oriented Activities

The most productive and lasting laboratory-university relationships are those based on cooperation in work-related activities, especially research. This can take many forms--consultation, individual association with colleagues, exchange of personnel, research contracts with universities and their faculties, cooperation in establishing new course offerings, employment of graduate students on thesis research problems, and joint research projects. Laboratories that enjoy this close scientific and technical cooperation with universities generally encounter little or no difficulty in eliciting university cooperation to meet their educational needs. Examples of such organizations include the Joint Institute for Laboratory Astrophysics, the Geological Survey, and the Forest Products Laboratory.

Joint research activities offer a particularly good opportunity to develop and strengthen laboratory-university relationships on the basis of mutual interest and respect. In a 1960 report the President's Science Advisory Committee stated: "Where it is feasible, new (Federal research) undertakings should be established in, or in close association with universities, and the great influence and effectiveness of basic research in existing government installations should be increased where possible by improving its connection to graduate education and to university scientists."[1]

The most complete example found by the task force was the partnership existing between the National Bureau of Standards and the University of Colorado which produced the Joint Institute for Laboratory Astrophysics (JILA). Here, university and Federal laboratory personnel are virtually indistinguishable--they work together on the same projects, share the same facilities and equipment, teach, hold faculty positions, and participate in university functions. The only recognizable difference seems to be the signer of their paychecks. (For more detail, see Appendix D.)

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[1] President's Science Advisory Committee, "Scientific Progress, The Universities, And The Federal Government," November 15, 1960, p. 31.

Effective university research ties may be accomplished without such complete intermixing of staffs. Both the Environmental Science Services Administration at Boulder and the National Aeronautics and Space Administration at various locations are attempting to develop university work-related relationships through the establishment of closely related but formally separated organizations located near their centers. Also the excellent voluntary cooperation existing among the governmental and non-governmental elements at places such as Flagstaff, Arizona, and Menlo Park, California--including the Geological Survey's National Center for Astrogeology and its National Center for Earthquake Research--exemplifies effective collaboration among separately funded research groups working on mutually interesting problems. The Forest Products Laboratory at Madison, Wisconsin, also makes use of some of these concepts.

In short, joint research between Federal laboratories and universities has proved to be highly successful in developing close laboratory-university ties. When cooperative projects are undertaken as the best method to accomplish the desired research, the associated potential educational advantages should be exploited fully.

RECOMMENDATION NO. 1: As a matter of policy, Federal organizations should take the initiative, where feasible and suitably related to the agency mission, in establishing joint activities with universities, such as joint research projects and training centers, as a desirable way to foster relationships which aid educational and training activities.

2. Education of Laboratory Employees

When the laboratory is located near one or more universities offering courses in fields of primary interest to the laboratory, the relationship may be no more substantial than the laboratory employees' taking and paying for courses on their own initiative. At the other extreme the laboratory may engage in extensive negotiations with universities to provide training closely related to the work of its employees, often on laboratory premises, with the laboratory making available teaching talent from its professional staff and providing other support such as classroom space.

a. Current Activities

Many employee training activities are closely integrated with the technical interests of the Federal laboratory. Where the laboratory support is direct and complete, the course work is almost always focused upon direct application to the missions of the laboratory concerned.

The majority of laboratories visited encourage university training programs that provide advanced technical education to members of their staffs. Problems of technical obsolescence are thus ameliorated and the overall competency of the staff is both broadened and brought up to date, thus benefiting the individual and the laboratory in the accomplishment of its mission. As a by-product incidental to the attainment of these goals, several members of the professional staff in these laboratories obtain a doctorate each year, either through local programs or through long-term off-site training. They are usually in their middle or late thirties by the time they obtain the Ph.D. degree. In general laboratory management is well satisfied with the results of these advanced technical training programs, feeling that a sufficiently high proportion of these professional employees are retained to justify the expense and inconvenience.

Methods are available to reduce the expense of long-term training and to assess the depth of motivation of members of the laboratory's professional staff who are prospective candidates for advanced degrees. Often it is possible for the employee to complete many academic requirements, including languages, while still working at his regular job--through home study, night courses at nearby universities, and administrative adjustment of the work week. Use of such methods produces more advanced education at less cost and a better selection of employees for the laboratory to support for long-term training.

One method sometimes used to evaluate the motivation and qualifications of employees toward advanced training is to require the employee to pay the costs of training for an initial period, such as the first semester. The laboratory then may contribute to payments for the remaining education, subject to continued scholastic success.

A number of laboratories or groups of laboratories located in areas at a distance from suitable university classrooms have been successful in bringing appropriate educational activities to their locales. Such programs include on-base university courses sponsored by the laboratory and supported in many ways, including payment of tuition charges, supplying classroom and office space, furnishing the services of training officers and other support personnel, guaranteeing minimum numbers of students, and facilitating university teaching appointments to members of the laboratory's professional staff. Regular university degree programs are involved, either through extensions, establishment of a local branch of the university, or establishment of a new university. Excellent results have been realized from such programs developed by NASA and Army at Huntsville, Alabama; Naval Ordnance Test Station at China Lake, California; and the laboratories at Wright-Patterson Air Force Base.

Examples of less isolated laboratories which have developed extensive programs to provide university courses leading to advanced degrees, include: Naval Ordnance Laboratory (White Oak, Md.); Naval

Research Laboratory and Harry Diamond Laboratories (Washington, D.C.); Natick Laboratories (Boston, Mass.); Ballistic Research Laboratories (Aberdeen, Md.); Langley Research Center (Langley, Va.); National Bureau of Standards (Washington, D.C., and Boulder, Colorado); and the National Animal Disease Laboratory, Department of Agriculture (Ames, Iowa).

Larger laboratories usually have more extensive employee training programs than do small laboratories. Laboratories oriented toward development activities also have somewhat more employee training activities than do laboratories oriented either toward research or testing. Department of Defense laboratories in general, and Navy in particular, have more extensive programs than do non-DOD laboratories. Chart 2 shows differences in employee training activities according to the six dimensions.

Few instances were found where significant training programs have been developed through the cooperative efforts of various Federal laboratories located in the same general geographical area. Although there are outstanding exceptions, mentioned elsewhere in this report, there appears to be little coordination of training efforts among field laboratories. Better exchange of information on training needs and activities could produce more opportunities for intra-agency and inter-agency training, additional university courses, valuable cross-pollination through interchange among participants, and reduced costs per person receiving training.

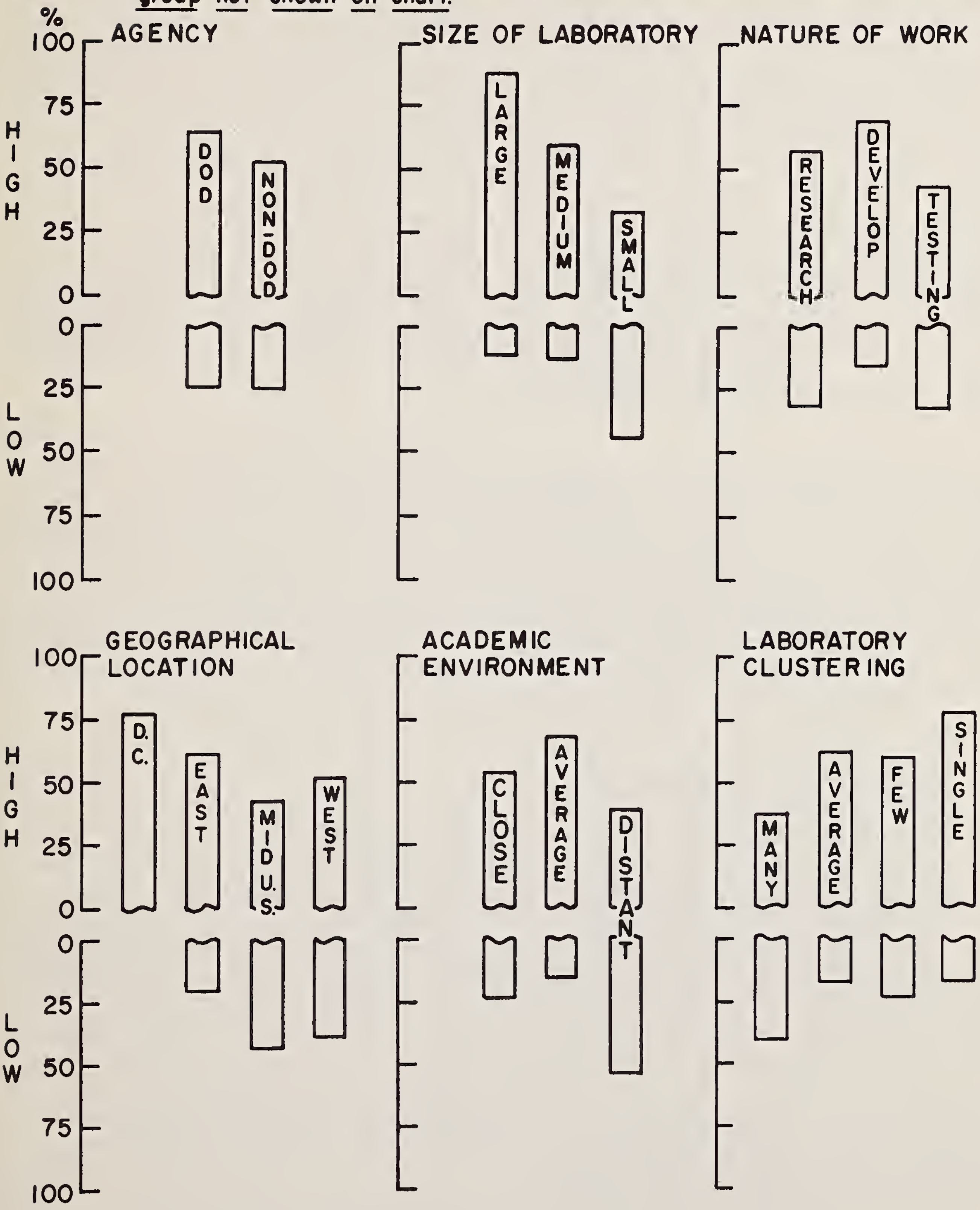
b. Government Employees' Training Act (GETA)

There is widespread satisfaction with the Government Employees' Training Act (Title 5 U.S. Code, Chapter 41). The Civil Service Commission is to be commended for its vigorous and positive leadership in administering the Act. The few criticisms voiced pertained to such things as the paperwork involved in reporting, unrealistic requirements for headquarters review and approval, minor restrictions of the Act, and the burden of obtaining exceptions to some provisions. Basically GETA was acclaimed by laboratory managers as being well conceived, comprehensive, sufficiently flexible to be responsive to changing needs, and of considerable benefit in helping laboratories develop effective education and training programs.

However, there is some confusion involving unnecessarily narrow interpretation of certain provisions of GETA. For scientists and engineers these provisions do not prevent the laboratory from reaching optimum training levels, but a considerable body of mythology has developed through hazy and incorrect interpretations. The principal items of concern are (1) the prohibition of training employees solely for the purpose of obtaining an academic degree, (2) the limitation of providing training to only one percent of the total work force, (3) the prohibition against providing training during an employee's first year of employment, and (4) the training limit of one year in ten for any particular employee.

CHART 2 - EMPLOYEE TRAINING ACTIVITIES

Percent of laboratories ranked high (extensive and effective employee training activities) or low (neutral or little; no significant input). Middle group not shown on chart.



To the extent that training programs are rarely approved by management unless there is some work-related benefit, prohibition (1) against training solely for obtaining a degree does not really represent an intrinsic limitation. Difficulties with this provision arise primarily from overcautious management interpretation of its meaning. The limitation of training to one percent of the work force (2) applies only to long-term training outside the agency and is computed on an overall agency or department-wide basis. Any limitation from this provision to date has been solely one of misinterpretation, since the one percent figure has never even been approached by any agency in actual practice. Support for eliminating items (3) and (4) as requirements is provided in the recent report by the Subcommittee on Manpower and Civil Service of the Committee on Post Office and Civil Service, House of Representatives (Report Covering the Effectiveness of Implementation of the Government Employees' Training Act, June 1, 1967). While any of the four provisions rarely create serious difficulties, headquarters and local laboratory interpretations arising from them do cause a considerable amount of red tape, delay, and excessive paperwork.

RECOMMENDATION NO. 2: In recognition that the establishment and operation of dynamic training programs is an essential requirement of laboratory leadership, departments and agencies should (1) fully publicize the many benefits and educational opportunities available under the Government Employees' Training Act; (2) provide positive support for making optimum use of these in the form of budgetary and staff ceiling allowances; (3) encourage field laboratories to develop training programs in cooperation with other nearby laboratories; (4) delegate to the maximum extent possible authority to heads of R&D laboratories for approving training; and (5) otherwise streamline procedures essential to the optimal utilization of the Government Employees' Training Act.

3. Education of Others

Activities involving education of persons who are not regular full-time laboratory employees often require broader long-range attitudes on the part of laboratory management, but the benefits to both the laboratory and the university are substantial. Examples of these types of activities are cooperative programs, summer employment of faculty members and students, contractual arrangements with universities and individual faculty members, postdoctoral fellowships and other flow-through programs. These activities are especially characteristic of laboratories which construe their mission to include advancing their particular area of science. The teaching, symposia, workshops, and other training given to university, industrial, State, local and other Federal government employees and others constitute an important use of Federal facilities in advanced training and education.

Federal laboratory activities in training those who are not employees are mission-oriented in the sense that they are directed to the recruitment and retention of staff members and upgrading the capability of the staff through interaction with students and colleagues. Benefits also accrue to the scientific community. NASA is authorized to foster educational activities as a direct contribution to their overall long-range mission; other laboratories that also recognize a direct responsibility for educational activities in their fields of scientific and technological interest include The Smithsonian Institution, Federal Water Pollution Control Administration Laboratories, National Center for Urban and Industrial Health, Walter Reed Army Institute of Research, Army Human Engineering Laboratories, Geological Survey, National Bureau of Standards, and the Public Health Service.

a. Advancing the State of the Art

Various Federal laboratories present lecture series and short-term professional advancement courses for the benefit of regular employees as well as people from universities, industry, State and local governments, other Federal laboratories and foreign countries.

- The Human Engineering Laboratories at Aberdeen annually present courses on technical subjects.

- The Bureau of Reclamation at Denver gives practical short courses in such subjects as soil mechanics, irrigation and electricity.

- The Geological Survey and the Agricultural Research Service each give extensive field training each year to upwards of a hundred foreign students through sponsorship by such organizations as AID and the United Nations.

- The National Center for Urban and Industrial Health, at Cincinnati, presents short-term courses with laboratory work and field exercises. Some 2500 to 3000 people including foreign nationals are trained each year, of whom 70 percent come from State and local governments, 15 to 20 percent from industry, and 5 percent from universities.

- Limited attention has been given to the development of texts and other course materials in connection with technical education programs. NASA's Ames Research Center produced a textbook based on a series of lectures presented by industrial experts; Water Pollution Control Administration prepared a variety of laboratory manuals, course outlines and other teaching materials for use throughout the country.

b. Programs at High School Level

Numerous Federal laboratories offer summer jobs to high school students. The motive is simple--to interest young people in scientific careers; the procedures are varied. Perhaps the pioneer effort in this area was made a number of years ago by the Washington Section of the American Chemical Society. Through its Education Committee, this group acted as intermediary between high schools and various scientific laboratories--Federal and others--in arranging several weeks of summer employment for a number of gifted students. The Society paid each student a modest stipend to cover his daily transportation and lunch expenses; the laboratories were put to no expense except for the time needed to stimulate and find useful work for the young people. This program has been continued and expanded under sponsorship of the American University, with the aid of a modest grant from the National Science Foundation.

Some laboratories sponsor "career day" and "engineer for a day" programs, wherein selected students are given vocational counsel or are paired off with laboratory engineers to observe their methods of operation. Another laboratory has an arrangement with the local high school whereby selected seniors work two hours per day for credit, over an extended period, in one of the laboratory's research units. Other laboratories offer jobs to local National Science Fair winners.

Efforts to improve high school curricula and teaching methods were reported at several Federal installations. Similar attention is being given to upgrading the competence of high school teachers. Teachers are brought into some laboratories either for attendance at seminars or for part-time employment. Federal scientists and engineers address high school classes, upon invitation, about their laboratory or on technical subjects.

c. Community Relationships

Many Federal laboratories endeavor to keep the general public informed of their programs and accomplishments through group tours, open houses, and reception of visitors, supplemented by information booklets, exhibits, and lectures by staff members. One example of significant community activity is a movement aimed at establishing a Greater Annapolis Graduate School to offer science courses for credit. The Naval Marine Engineering Laboratory is spearheading the effort which includes other Federal laboratories in the Annapolis area, State and local governments, universities, private industrial groups, chambers of commerce and local teachers. The Air Force laboratories at Wright-Patterson AFB have collaborated with the community of Dayton, Ohio, as well as with Ohio State and Miami Universities, in the establishment of Wright State University.

d. Differences Among Laboratories

Relationships of the type discussed in this section are found most frequently in large Federal laboratories. Laboratories with strong research orientation develop more extensive relationships of this type; laboratories with testing and evaluation orientation have much less extensive relationships; laboratories oriented more toward developmental activities fall between these two groups.

SPECIAL PROBLEMS

1. Curriculum Development

One important product of effective university-laboratory relations is the opportunity for the laboratory to cooperate in curricular changes of universities. Changing social and economic needs lead to new problems--often reflected first in Federal programs--which cause new mixes and shifts in emphasis of educational activities. Because of expanding new fields and shrinking old fields, curriculum gaps develop in science and engineering. Among the broad "new" national fields in which insufficient numbers of trained professionals are available are the earth sciences--oceanography, hydrology, meteorology; among the "old" fields are materials research, topography, and mining engineering. Some fields of specialization have always been offered at only a few universities in the country because of special circumstances.

Specialists in particular fields of science and technology are in short supply nationally. These fields may be offered by so few academic institutions that Federal laboratories in most locales may be unable to meet their requirements for scarce personnel. (Examples: air and water pollution, waste disposal, radiological health, veterinary pathology, pharmacology and toxicology.)

The Federal laboratories, individually and collectively, could be and are of considerable assistance to universities in helping to overcome these shortages. Individual laboratories have often prevailed upon universities to offer specific courses where sufficient need can be demonstrated within the laboratory, particularly in places where active after-hours educational programs exist. Various short-courses given by a laboratory have subsequently acquired university sponsorship. Of more value to science and technology are the joint efforts of academic and governmental interests in developing new options and fields within university programs that are open to all students, including laboratory employees. Federal participation has included designing the curriculum and specific courses required by emerging disciplines or new fields, furnishing laboratory personnel as instructors on a temporary basis, and providing fellowships for others and training for their own employees. Endeavors of this type require good university-laboratory relationships. Among the organizations effective in assisting universities to close curriculum gaps, or to change educational emphasis as science and engineering fields change, are the National Bureau of Standards, Geological Survey, National Aeronautics and Space Administration, elements of the Public Health Service, Water Pollution Control Administration, and the Department of Agriculture.

In 1966 Ames Research Center (NASA), in cooperation with Stanford University, constructed a summer course on how to teach systems engineering. It is taught jointly by Stanford and Ames personnel, includes practical experience and demonstration, and the "students" are faculty members from universities all over the country--employed for the summer by Ames primarily to take this course. Preference is given to small faculty teams from participating university departments. These professors are expected to work toward inclusion of systems engineering courses and degree options at their own universities.

2. Difficulties with Universities

Universities are under considerable pressures in all of their major roles--as educators, as researchers, as citizens of the community. With limited resources, they must achieve some balances among the various demands upon them. Educational needs of Federal laboratories are one of these demands. In general universities have cooperated extensively in continuing programs and in developing new programs which benefit Federal R&D laboratories. The record is one of much cooperation and mutual benefit.

However, there is a noticeable tendency on the part of some universities to withdraw from cooperative educational ventures with Federal laboratories, affecting both after-hours educational programs and the university's regular advanced degree programs. Some universities that in the past cooperated in setting up extensive after-hours programs, are currently reluctant to extend them or to participate in similar new programs with other laboratories. In at least one case a university is withdrawing completely from an extensive program of many years standing, thus precipitating a crisis at the affected Federal laboratory.

Difficulties developing in regular university advanced degree programs involve increased residency requirements, and reluctance to accept part-time students or thesis and dissertation work based on Federal laboratory research. These difficulties may result from change in university policy, or from decisions made by department chairmen or individual faculty members.

While these difficulties are by no means universal, they are a considerable problem to some laboratories.

RECOMMENDATION NO. 3: The Office of Science and Technology should request the American Council on Education to participate with Federal representatives in studying ways of improving university—Government cooperation in education and training programs of mutual interest, including an evaluation of the conditions causing university withdrawal from some laboratory educational activities.

DIFFICULTIES WITH HEADQUARTERS

While many laboratories report no difficulties of any appreciable magnitude with their headquarters office, citing aid rather than hindrance, approximately half of the laboratories reported serious difficulties that hamper their education and training activities. Many factors that concern laboratory operations as a whole--"hiring freezes," limitations on the number of higher grade employees, average grade restrictions, detailed manpower management from afar, lack of delegation of authority, etc.--have a marked effect on education and training efforts. Discussion in this report is limited to those administrative considerations not under local control that more clearly and directly affect relations between Federal laboratories and the academic world.

1. Nature of the Difficulties

The educational program of a laboratory must compete with all other activities for its resources. At half of the laboratories visited restrictive manpower ceilings were cited as a serious difficulty. Of particular concern are those headquarters offices which impose rigid and detailed manpower ceilings that include WAE and part-time employees, and which "take away spaces" of personnel who are engaged in long-term training. This problem has been alleviated in DOD installations by establishing a central pool of manpower spaces and salary funds to make it possible for laboratories to detach staff members from critical assignments to engage in essential training. (See Appendix H.)

At about a fourth of the laboratories it was felt that funds available were insufficient for an optimal educational activity.

About a third of the laboratories visited made a point of the delay and difficulty caused by requirements for review and approval by higher echelons of many details of laboratory operation. Some laboratories made a special point of the delays in obtaining approval for publication or presentation of technical papers at professional meetings; the delay in approval can be several weeks or more--much more. Many installations reported delays and difficulties in getting headquarters approval for training under the Government Employees' Training Act, which adversely affects the planning of the employee and the laboratory. Much of the difficulty stems from different interpretations of the wording in the Act. It is clear that adequate authority is not always being delegated to the laboratory director level.

2. The Bureau as a Buffer

Narrow interpretations, unrealistic administrative delay and red tape need not necessarily prevent a field laboratory from developing effective university relationships. Some individual laboratory directors are apparently able to minimize these difficulties by liberal but reasonable local interpretation of unrealistic directives. Of more significant general import is the buffer role played by some organizations at the bureau level. These bureaus have been able to absorb departmental and other policy actions and requirements without feeling it necessary to impose rigid restrictive interpretations. As a result, their field laboratories have been able to operate in an atmosphere of relative freedom and to develop effective relationships with universities --without resentment toward their own headquarters. Examples from two different metropolitan areas illustrate this important point.

In one area, located within a few hundred yards of each other, the task force found two field laboratories of two different bureaus of the same department. There the resemblance ended. One of the laboratories was proud of its effective university relationships--including personnel interchange, equipment interchange and joint research activities. The other was unable to develop effective relationships because of "unreasonable departmental requirements." In another metropolitan area two laboratories in the same department, but under different bureau control, were located in the same complex of buildings. Similar differences were found as in the first example cited. Management of the two less effective laboratories (in terms of university relations) elaborated at great length on the shortcomings of their department, whereas the two "effective" laboratories credited their headquarters bureau with aiding them in developing university ties and seemed unaware of the same department's "shortcomings."

The existence and effectiveness of individual supervisors who act as buffers are well known. Research in the social sciences indicates that such supervisors are more successful in developing effective work forces with good morale and better productivity. The question being raised here is whether the same buffer principle is actually working in the same effective manner insofar as whole bureaus and laboratories are concerned. The evidence suggests that it is, and that it is successful.

3. Need for Action

There is need for top level departmental support and encouragement of education and training activities, particularly in recognizing the importance and benefits of university relations, personnel interchange and equipment interchange between Federal laboratories and universities. Policies should recognize the outstanding gains and benefits that accrue to the Federal science and engineering laboratories by interaction with promising young scientists and mature leaders from other environments. Efforts of local managers to sustain and expand the present level of activity should be strongly supported. Some alleviation of the restrictions on employment, travel, funding and manpower is necessary if Federal laboratories are to achieve a more nearly optimum level of interchange.

Laboratory directors often are not sure that headquarters will consider their training plans and activities to be desirable, justifiable, within their authority, and appropriate to their mission. While they desire considerable latitude and permissiveness, they also want some assurance that headquarters supports the type of activities necessary to encourage laboratory directors to engage in these activities more fully.

RECOMMENDATION NO. 4: In accordance with the intent of the President's memorandum "Strengthening Academic Capability for Science Throughout the Country," departments and agencies should issue policy guidelines for the development of specific programs to improve Federal laboratory—university relationships.

Many laboratory managers expressed keen interest in knowing how their training and education activities compared with those of other laboratories, both for comparative purposes and for the possibility of picking up ideas they could profitably adapt to their own situation. Numerous inquiries were received on specific programs in operation in other laboratories--how they worked, how the procedures were handled, the required authorizations, approvals, expenses, benefits. There is unquestionably much interest on the part of laboratory management in finding out what training exists and works elsewhere.

Various laboratory managers were also disturbed at their lack of communication with policy makers who establish much of the framework within which the laboratory must operate. Too frequently they felt that their own headquarters simply passed requirements and decisions along to the field laboratory director, without themselves having a clear understanding of the impact of the directives on the operations of the affected laboratory. Laboratory managers felt that they had little or no opportunity to affect basic decisions that have important impacts on their programs. Better communication and appreciation of the goals and problems faced at different echelons could be enhanced by conferences involving top departmental officials, bureau chiefs, division chiefs, and field laboratory directors.

It is hoped that the results of this study by the Committee on Federal Laboratories, coupled with action by the Federal Council for Science and Technology, will be useful in alleviating some of the problems in the two types of communications discussed immediately above.

INTERCHANGE OF PERSONNEL

Without question, management in most Federal laboratories is committed to the essentiality of continuing interaction between the Federal scientist and his counterpart in other environments. A multiplicity of programs and mechanisms exist for stimulating a vigorous exchange of scientific information and viewpoints between Federal laboratories and other organizations. A steady flow of non-Federal scientists through the Federal laboratory under relatively short-term conditions is important and so is the flow of Federal scientists through non-Federal institutions. Desirable personnel interchange in some Federal laboratories is also accomplished through the rotation of members of various uniformed corps.

In general, laboratories that are strongly oriented toward research place much more emphasis on personnel interchange programs than do laboratories engaged in testing and evaluation activities; laboratories oriented primarily toward developmental activities fall between these two extremes. It is logical to assume that maximum interaction would occur in situations where research laboratories are located on or near the campuses of good universities engaged in teaching and research in similar areas of science. Indeed this is the case! There is also some tendency for personnel interchange programs to be more active in larger laboratories, and laboratories located in areas where there are only a few or no other Federal laboratories performing somewhat similar work. Chart 3 indicates differences in the level of personnel interchange in relation to six variables.

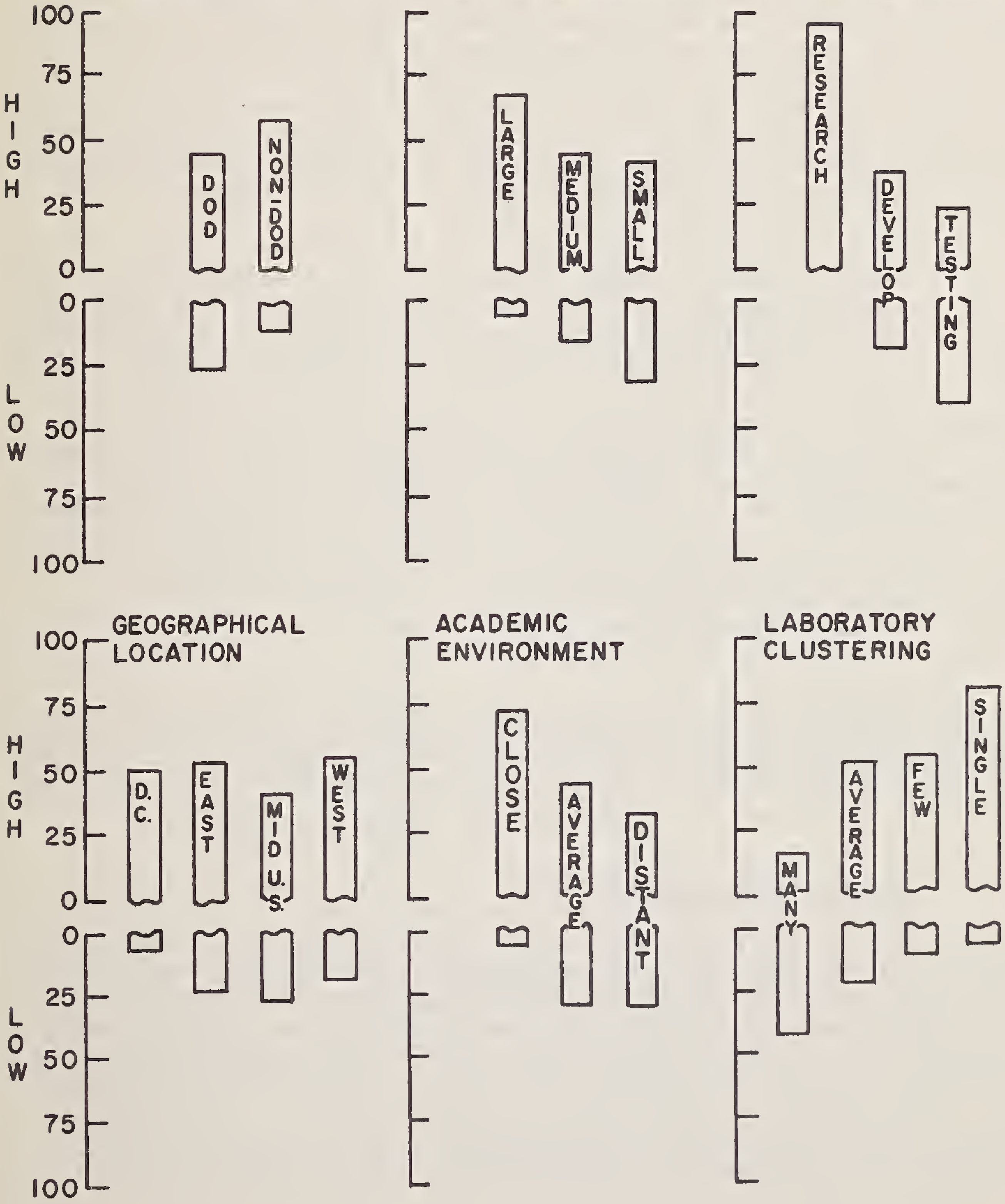
FLOW-IN FORMS OF PERSONNEL INTERCHANGE

1. When Actually Employed (WAE) Mechanism

Most laboratories use the WAE form of employment to some extent to assist the regular work force in developing new ideas and better approaches to problems. WAE appointments are favored over other arrangements to the extent they do not count against employment ceilings. Such appointments are easily effected under authority delegated to the laboratory director. Ability to make on-the-spot commitments is crucial in encouraging scientists and engineers to participate in research programs of the Federal laboratory. Use of WAE appointments avoids ambiguities in matters of patents, tort claims, accidents, conflict of interest, publications, and other potentially irksome situations which are sometimes associated with personnel interchange. WAE appointments represent an effective method to provide interchange between Federal and university programs and people, and to obtain consultative services.

CHART 3 – PERSONNEL INTERCHANGE

Percent of laboratories ranked high (extensive and effective personnel interchange) or low (neutral or little; no significant input). Middle group not shown on chart.



There are several examples of outstanding success in using WAE employment as an interchange medium:

(a) The Geological Survey has traditionally used WAE appointments to establish an intimate working relationship with the academic community. Several hundred graduate students and professors are employed on a temporary basis by the Geological Survey through this device. Appointees receive regular salaries and expenses and have full access to laboratory facilities and supporting services. In the Geologic Division, approximately half of the geologists hold doctorate degrees, and a substantial number of these represent people who were attracted to the Division's laboratories during their WAE tours. Appendix E describes the development of this program in more detail.

(b) The Forest Products Laboratory at Madison, Wisconsin, uses a form of WAE employment for the purpose of making awards for graduate study to outstanding students with recent baccalaureate degrees, principally in engineering or chemistry. Those selected must be approved for graduate study by the University of Wisconsin and meet the requirements for career conditional appointment in the Federal civil service. Annual income is equated to the value of a university fellowship. Job sheets covering employment in the laboratory include duties which also satisfy thesis requirements of the university. The thesis problem is selected by the laboratory supervisor, who also functions as the student's preceptor. Not only has the program been productive in providing a steady influx of bright young professionals into the laboratory, but it has also led to permanent employment in many cases.

RECOMMENDATION NO. 5: Laboratory managers should make more extensive use of flexible procedures, particularly WAE appointments, to promote the interaction of university personnel with the regular full—time professional staff; manpower ceilings should recognize the need for such appointments.

2. Contractual Arrangements

Many laboratories feel the need of strengthening their technical contacts with the scientific community through coordinated work activities. One commonly used approach is the negotiation of contracts that expressly provide for collaboration between Federal and other scientists in carrying out cooperative research projects. For these purposes, contracts may involve a university, one or several of its departments, or one or more professors and/or their graduate students. The versatility of the contract mechanism is illustrated by numerous examples found during the visits to Federal laboratories.

(a) The Aerospace Medical Research Laboratory (Air Force at Wright-Patterson) has established a highly specialized cardiopulmonary laboratory under a contract with a university. The staffs of both institutions use the facility and the pooled effort of both parties attracts scientists from all over the world, partly because of the unique facilities but more importantly because of the high quality of the research contributions.

(b) Several laboratories have contracts with a university or a consortium to establish special institutes for carrying out cooperative research ventures. The Langley Research Center, for example, has created the Virginia Associated Research Center where academicians work with Federal scientists and engineers using the exceptional and costly specialized equipment and facilities at the Center. A more detailed description of this arrangement is contained in Appendix F.

(c) A Navy laboratory is developing a university coupling program in part by placing contracts with selected universities, particularly those interested in enhancing their teaching and competence in oceanic research. Laboratory management is injecting an academic flavor into the environment by interlacing their work with that of universities.

(d) An Agricultural Research Service laboratory has a master contract with a leading west coast university including a range of scientific endeavors to promote concerted effort in solving problems of mutual interest. Specific projects may be added or deleted by simple amendment of the basic instrument.

(e) Many laboratories use contract procedures to make their facilities available to graduate students and professors for research pursuits under conditions where the individual does not lose his identity as a student or faculty member. Many of the faculty members engaged under contract are prominent scientists from leading universities in the country. Contracts also are used to permit reciprocal use of unique and special equipment owned either by the laboratory or by universities.

3. Cooperative Employment Mechanisms

Personnel interchange at the student level is frequently achieved by cooperative employment agreements. The laboratories that use the device successfully usually have (1) provided for unusually challenging work assignments during the student's undergraduate employment, (2) paid part of the student's tuition and other costs, and (3) concentrated their recruiting efforts on those whose residency or other personal ties are close to the laboratory site. There are several basic types of cooperative programs.

Most numerous are work-study programs involving agreements between laboratories and participating universities and featuring interchanging tours of on-the-job training and classroom exercises based on modification of the usual academic schedule. Typically the student is recruited for career conditional appointment during or prior to his freshman year of college, and receives three months or more of on-the-job experience during regularly scheduled breaks in each academic year. The student is promoted to progressively higher duties as he advances in his academic work. After graduation he is eligible for continuing employment at GS-7. This type of employment is designed to create a reservoir of promising young professionals for future career service in the laboratory, while also assuring the laboratory of a continuing source of technician capability during the students' periods of actual employment.

Less frequently a laboratory will offer continuing summer employment to undergraduates through the WAE mechanism, or by more formal arrangements which involve an outside group or university. As an example of the latter method, the Geological Survey through cooperation with the National Association of Geology Teachers employs top-ranking students in its summer geology field camps. Students are selected by the Association and obtain field experience working with world-renowned geologists.

Many laboratories offer summer employment to students and faculty through conventional Federal mechanisms. Recent changes in Civil Service Commission examining procedures for summer positions are presenting difficulties to some laboratories, since they remove some of the necessary flexibility which has existed in the past.

A few laboratories are now entering into cooperative agreements at the graduate level. It seems clear that this will become increasingly necessary if the Federal laboratories are to attract and retain their fair share of bright graduate students.

4. Special Programs for Interchange

Some equally impressive programs are more formalized. With the exception of the National Academy of Sciences-National Research Council (NAS-NRC) Postdoctoral Resident Research Associateship program, these programs are distinctive to a particular organization and its subordinate laboratories.

(a) The NBS (Industrial) Research Associate Program

The Research Associate Program of the National Bureau of Standards makes it possible for qualified scientists and engineers from industrial corporations, technical trade associations, professional societies, and other government agencies to work for six months to two years (occasionally longer) at the Bureau on research projects of mutual interest to the sponsoring group and NBS. Salaries are paid by their parent organization. (See Appendix G.1.)

(b) The NIH Visiting Program

This program was launched in 1950 to facilitate the appointment of foreign scientists in the research programs of the National Institutes of Health. The basic intent of the program is to encourage the exchange of concepts, research approaches, techniques and philosophy between NIH scientists and those of other nations in pursuit of common goals. Salaries may reach a maximum of GS-18. During the past five years more than 950 appointments have been made from 50 different countries. Almost all of those appointed have returned to their native lands after one or two years. (See Appendix G.2.)

(c) The NIH Staff Fellowship Program

The program is keyed toward providing young scientists at the postdoctorate level with opportunities for research and advanced training by working in close association with senior investigators of the National Institutes of Health. Each fellowship is awarded for a two year period and may be extended for an additional year. Upon completion of his training the Staff Fellow is released to accept a career of his choosing. Stipends approximate the GS schedules appropriate for the discipline. Some 90 fellowships have been awarded since 1963; 13 of the Fellows have remained with the NIH, 22 have left, and the remainder are still in training. (See Appendix G.2.)

(d) The NASA Summer Faculty Fellowship Program

This program is conducted in cooperation with the American Society for Engineering Education and several sponsoring universities. It makes the National Aeronautics and Space Administration research centers available to faculty members for research studies and other programs. (See Appendix G.3.)

(e) The NAS-NRC Postdoctoral Resident Research Associateships

Some eleven agencies participate in this program; the primary users are the National Bureau of Standards, the Naval Research Laboratory, and the Agricultural Research Service. The National Academy of Sciences-National Research Council examines the credentials of each laboratory that wishes to participate and accredits it for postdoctoral education. A student applies to the NAS-NRC for appointment, usually after having talked over his research plan with his future advisor, a Federal laboratory employee with whom he wishes to work. NAS-NRC screens the applicants and prepares a certified list. The laboratory is then free to appoint applicants for a one year term at the GS-12 level, renewable for a second year. Between 1961 and 1966, 656 students have applied, 546 have qualified, and 282 have been appointed. The program has been successful at a few laboratories, particularly at the National Bureau of Standards. It has enjoyed less success in some of the other participating organizations, in part because of the lack of applicants to those organizations.

(f) The Goddard (NASA) Institute for Space Studies

The Institute, located in New York City, serves as a bridge between NASA and scientists in the non-Federal scientific community. The in-house staff is composed of NASA scientists, who work with faculty members of local universities, visiting scholars, and Resident Research Associates. The latter are selected and funded through a grant to the National Research Council under a national program of resident research associateships in which the Institute and seven NASA centers are the participants. Resident Research Associates at the Institute come from all over the world, are primarily postdoctoral researchers, and usually remain with the Institute for one year. (See Appendix G.4.)

5. Need for a Visiting Program

The varied and multiple forms of personnel interchange now in existence take many dimensions, as noted above. Variations have developed out of necessity because of the absence of suitable government-wide authority. Thus, while one laboratory may resort to the use of the WAE instrument, another cannot do so because of organizational restrictions. Similarly, where some laboratories have adequate contract authority, other laboratories find it virtually impossible to enter into any satisfactory type of agreement. A few laboratories have special statutory or other authority for establishing personnel interchange programs; most, however, do not. Although the NAS-NRC postdoctoral research program facilitates some degree of interchange at the immediate postdoctoral level, it cannot meet the full needs of laboratory management: there are not enough qualified applicants, salaries are often too low, laboratories lack sufficient manpower ceilings to absorb additional temporary staffing, and the procedures do not permit selections several times a year.

Laboratory directors interviewed expressed strong need for a more comprehensive type of government-wide visiting program that would incorporate the best features of the many special programs now found in some Federal laboratories. No one thought his own program was completely adequate.

Legislation authorizing a new visiting program should remove certain fringe benefit deterrents to effective interchange. University and industrial scientists and engineers often find it possible to accept even temporary government employment only at unreasonable financial disadvantage. This is particularly true of the mature scientist who has achieved a considerable investment in a number of fringe benefits plans --the extent of which is often a measure of his scientific stature and value to his employer. New legislation should allow a person temporarily detailed to the Federal establishment to retain the full benefits traditionally continued during a person's temporary leave of absence from his regular employment, including his salary on sabbatical leave, continued coverage under retirement and other insurance plans, and his entitlement to vacation. Failure to accomplish these desirable objectives would make it imperative that any new legislation at least permit immediate coverage under comparable Federal plans.

Optimally, a new program should include authority to:

(a) Hire promising young postdoctorals as well as distinguished scientists for periods up to five years;

(b) Make such appointments outside the competitive civil service and outside of ceilings on permanent, full-time employment;

(c) Pay travel and moving expenses to the place of employment, as now authorized for shortage category positions, and provide for return travel as well;

(d) Delegate to laboratory directors the right to conduct direct negotiations and select candidates, subject to postaudit by appropriate higher authority;

(e) Permit the hiring of aliens; and

(f) Provide immediate entitlement to appropriate life insurance, annual and sick leave, health benefits and compensation for injury as needed to complement any arrangements the individual makes with his permanent employer. This should include supplemental payments or other actions, if necessary, to provide "no-loss" continuity in the individual's retirement benefits. The present restriction against allowing annual leave during the first 90 days of service should be removed.

RECOMMENDATION NO. 6: The executive branch should vigorously support legislation authorizing a Government-wide program for visiting scientists and engineers. It is essential that any new program incorporate provisions that make such appointments as far as possible on a "no loss" basis, and that remove many of the present deterrents to effective interchange with universities and other organizations.

FLOW-OUT FORMS OF PERSONNEL INTERCHANGE

The present flow of interchange is heavily one-way. Considerably more non-Federal scientists and engineers pass through the Federal laboratory than there are Federal scientists disengaged from the laboratory to benefit from the associations found in new environments. To the extent that there is any significant activity which releases the Federal employee from his regular job, it usually takes one of four forms.

1. Change in Duty Station

The Federal scientist receives refresher experiences by job-related assignments at a different duty station, to work with important leaders in research centers throughout the world. The stimulation and benefits of exchanging experiences and viewpoints with colleagures are realized by such assignments, and significant research is usually accomplished in the process. Individuals sufficiently mature and responsible to warrant such experiences need no direct day-to-day supervision; hence, assignments can be made anywhere. Changes in duty stations are relatively easy to make, but very few laboratories have taken advantage of the opportunity.

RECOMMENDATION NO. 7: Departments and agencies should encourage laboratories to make greater use of change of duty stations to facilitate the flow of Federal scientists and engineers into other research centers for limited periods.

2. Fellowship Programs

A limited number of fellowships (Sloan, Fulbright, Guggenheim, etc.) are currently available to Federal employees and others, on a competitive basis. The honorific and prestige value of these awards makes them unusually attractive to the Federal scientist and engineer. Secretary of the Army Fellowships are available to Army employees.

3. Long-Term Training

Graduate and postdoctoral training under the Government Employees' Training Act is the most frequently used formal mechanism for placing the scientist in a university setting, either for graduate training or for refresher experiences. This mechanism has obvious shortcomings as an interchange device, since it is primarily a tool to supplement formal training rather than a deliberate mechanism to provide for interaction with university peers. More use of GETA should be made for long-term training.

4. Informal Mechanisms

Generally of much shorter duration, but nevertheless vital in maintaining contact between Federal laboratory professionals and their non-Federal colleagues, is a group of activities such as attending scientific and technical meetings, travel for consultation, attending short courses away from the laboratory, and teaching at universities on a part-time or other temporary basis. Such activities are essential to dynamic laboratory programs.

(a) Teaching Activities

Many Federal professional employees teach at universities, usually on their own time and frequently at night. Occasionally, in special circumstances, these teaching activities are performed without compensation during regular work hours as part of the job. Appointments from universities run the range from full academic status, including voting privileges and thesis advising, to that of part-time lecturer for on-site teaching purposes only. These activities stimulate the scientist or engineer involved and keep him attuned to the latest developments in his field, improve the quality of student and regular research, produce more thesis work in Federal laboratories, help meet residency requirements for advanced degrees, improve laboratory-university ties, and aid in professional recruitment efforts.

(b) Attendance at Professional Meetings

Laboratory directors uniformly recognize that attendance by scientific personnel at meetings of professional societies is essential to a vigorous and modern research organization. Many Federal employees also participate in the activities of such societies, at both national and local levels, serving as officers, councilors, committee members, participants in symposia, etc. Although individuals engage in these activities voluntarily and on their own time, out of a sense of obligation to the ideals of the profession, their efforts reflect favorably upon the Federal laboratory. Much of this work involves the encouragement of secondary school students to develop an interest in scientific careers; all of it is concerned with the advancement of the scientific discipline concerned.

About half of the laboratories visited reported serious difficulty in sending employees to scientific and technical meetings. At some installations this results from a general reduction in funds for travel of all kinds, but at others it stems from specific restrictions on travel to scientific, technical or professional meetings. The restrictions applied recently reportedly have had a bad effect on morale. A great many employees attend meetings on leave at their own expense. Other important professional activities have also been affected: some highly useful short courses which involve travel have been discontinued, and at least one group of laboratories has discontinued use of faculty members as consultants because of the lack of travel funds.

Relief in this area is badly needed, especially in those laboratories oriented toward research, since these types of activities are by far the greatest source of stimulation the Federal scientist normally receives from his non-Federal colleagues. Curtailment of attendance at international meetings presents additional difficulties in some fields of science and technology in terms of the image of the United States' capability and interest in the eyes of foreign countries. Directives to cut back on these types of travel have been implemented by the various departments and agencies in different ways, some more damaging to the laboratories than others. The impact on research programs can be unusually severe in cases where large development, testing and hardware programs are mixed with projects of a research nature in the same installation. The immediate necessity of travel to monitor the assembly, testing and operation of equipment frequently means relatively little reduction for these programs. However, in order for the installation to meet overall travel cuts imposed on them, drastic compensating reductions are made in the informational exchange type of travel engaged in by the research staff.

RECOMMENDATION NO. 8: The Office of Science and Technology is urged to promote full understanding by top administrative officials as to the vital necessity of maintaining scientific interchange through attending professional meetings, with a view toward obtaining a realistic appreciation of the essential nature of these activities.

INTERCHANGE OF EQUIPMENT AND USE OF GOVERNMENT FACILITIES

The National Science Board has recommended that:

> "Unique or unusual research facilities at Federal laboratories and Federally-supported research centers should be made available to the national scientific community to the maximum extent possible, especially to qualified academic scientists who would otherwise not have access to such facilities.
>
> ". . . when such facilities are used by academic scientists, the costs incurred by the center for the operation of its unique or unusual research facilities should normally be funded by the agency responsible for the operation of that center. The related research costs incurred at their home institutions will normally be borne by whatever agency supports their research but may, occasionally, be borne by the agency responsible for operation of the center."

To help evaluate this recommendation the Committee on Federal Laboratories made a survey of the types and extent of interchange programs presently being carried out within the Federal agencies and departments having significant R&D activities. In addition, information was supplied by the task force based on its discussion of related subjects with managers of the laboratories visited and specific discussion of the NSB proposal at 12 laboratories.

THE PRESENT SITUATION

1. There is already a large amount of interplay with non-Government personnel and use of Federal facilities by universities at the majority of Federal laboratories. While the use of highly unusual or unique equipment and facilities is necessarily limited by the number and types

of such equipment available, there are many impressive examples of the sharing of unusual government resources with the scientific community at large. For example:

a. Several DOD and NASA laboratories make wind tunnels available.

b. A Forest Service laboratory has two of the only three specially designed electron microscopes available in the world for wood analysis. This laboratory's wood and pulp samples, the most complete in the world, are also used by non-Federal scientists.

c. A NASA-owned cyclotron is used approximately half of the time by a consortium of five universities.

d. A DOD laboratory makes available a cyclotron, a linear accelerator, and a Van de Graaff accelerator. Another DOD laboratory is installing a cyclotron designed to permit the generation of radiations for a wide variety of purposes. This costly facility will permit high neutron dosages of large animals; in this respect it is not duplicated elsewhere. This cyclotron, and a Van de Graaff accelerator, will be used extensively by non-Federal scientists.

e. Many space research and sounding rocket facilities in NASA have been developed and used to launch experiments in which the scientific community has been able to participate extensively. The majority of experiments involved in earth orbital launches have been of this nature.

f. Agricultural Research Service laboratories have the world's best collections of bacterial cultures and parasites important to agricultural sciences; these attract investigators from all parts of the world.

g. One of the world's best astrometic telescopes (Navy) is used extensively by other observatories, by university faculty and graduate students, and by other long-term visitors.

2. There is a wide range of responses and qualifications from the individual laboratories in respect to this subject. Where a long list of associated problems were presented to the Committee task force, almost invariably that laboratory did not have a particularly active relationship with universities. Where these problems were minimized or not discussed at all, generally that laboratory had a considerable amount of interaction with the academic community.

3. One of the most striking differences in receptivity to making Federal equipment more readily available for use by universities was along a "nature of work" continuum characterized broadly as Research-Development-Testing. (Most of the "testing" activities occur within the

Defense establishment and NASA, although NASA and DOD also conduct vigorous research programs.) About 85 percent of the laboratories nearer the research end of this continuum responded positively to the possibility of increased interaction and have a history of making their equipment available to universities, compared to 50 percent of the development laboratories and almost none of the laboratories nearer the testing end of the continuum. These obvious differences can be attributed to the nature of work (including security classification) and/or the suitability of the equipment involved. Presumably Federal research personnel are doing work and using equipment more directly compatible with the interests of the university faculty and students.

4. Another clear difference in response can be attributed to the location of the Federal laboratory relative to universities. Those laboratories located in what could be called a "rich" academic environment favored the proposal from the National Science Board and have engaged in such activities extensively. On the other hand, a much greater number of laboratories located in more "academically isolated" environments responded neutrally or unfavorably.

5. Some Federal laboratories report that they would welcome university use of their facilities but that universities apparently are not interested. Despite extensive advertising by several laboratories, few responses have been received from universities. In some cases this may be due to the Federal laboratory being located too far from the university; in others the university's fields of interest apparently are not the same as the laboratory's. Disinterest may also occur when the university's equipment is better than that of the laboratory or the university prefers to develop its own equipment.

6. There is a wide variation in laboratory estimates of costs incurred in accommodating outside users of their facilities. However, evaluation of the total information gathered by the Committee indicates that such costs would require budget recognition if present practices are to be significantly increased. The extent of the Federal Government's financial partnership already existing with universities can be seen in the following paragraphs from the Congressional Record of March 13, 1967.

During the period 1954-1964

> ". . . Research and Development (R&D) expenditures in our universities and colleges increased at an annual rate of 16 percent, climbing from $290 million in 1954 to $1 billion, 300 million in 1964. Research and Development expenditures in the university-administered FCRC's (Federal Contract Research Centers) also increased at this same rate.

> "In 1954 the Federal Government only financed 55 percent of the $290 million spent for R&D in our universities. By 1964, we were financing 72 percent of the $1 billion, 300 million spent for R&D. The Federal Government, moreover, financed virtually all R&D in the university-administered FCRC's. That part not financed by the Federal Government in our colleges and universities came from several sources, the largest amount from individual universities' own State and local governments."

DISCUSSION AND RECOMMENDATION

Since 1901 Federal agencies have had authority to make their research facilities available to qualified scientific investigators, students, and university faculty members (31 Stat. 1039, 20 U.S. Code 91), and in recent years several Presidents have enunciated this as a clear Federal policy.

Today, the use of Federal facilities and equipment by university and other scientists constitutes a significant and productive partnership between the Federal laboratory and other R&D institutions. These activities stimulate scientist-to-scientist associations and contacts and directly influence organizational vitality and renewal.

Equipment interchange and sharing takes many forms, with many laboratories operating in an atmosphere of mutual cooperation with universities and other centers for science, some to the point of almost indistinguishable joint use of each others facilities. The use of highly unusual or unique Federal equipment and facilities is necessarily limited by the number and types of such equipment available on the national scene. University scientists and students are the major non-Federal users of this equipment; however, there are also many occasions when qualified scientists from other institutions also use Federal equipment for research purposes.

Laboratory managers who consider advancement of science in their field to be an integral part of the laboratory's overall mission generally cooperate extensively with appropriate universities and others in the use of equipment, personnel, and other facilities. However, while there is general agreement about the many benefits and gains which accrue from increased equipment sharing between the Federal laboratory and other R&D organizations, there are several factors which serve to inhibit or suppress the development of a more optimum level of activity in some laboratories.

The most important constraint is the absence of a Government-wide policy statement, supplemented by strong written directives from individual departments and agencies, giving positive support and encouragement to local laboratory management efforts to develop programs and techniques for increasing the use and sharing of Federal equipment and resources. Many laboratory directors are unqualifiedly enthusiastic about the benefits that result from increased interactions between the Federal scientist and his counterpart in universities and other science organizations. However, despite the various directives and Presidential statements expressing the desirability of such closer and strengthened relationships, these messages have not always been transmitted to the local Federal laboratory directors who must ultimately negotiate and implement agreements with interested scientists from other R&D organizations.

A difficulty in some organizations is money and manpower ceilings. This problem may take one of two forms: (1) Insufficient funds to operate equipment to the maximum extent possible, or (2) restricted personnel ceilings which effectively preclude the use of equipment and facilities during extra shift periods when the equipment would otherwise be available. Clearly, if the present level of equipment interchange is to be increased in organizations where these difficulties are found, there must be appropriate recognition of actual budgetary and ceiling needs.

Another constraint involves the question of liability in case of injury to personnel and damage to equipment or experiments. This problem can be overcome through special agreements defining the liability responsibility of the Government and the other parties. An equally effective approach is for the Federal laboratories to appoint outside scientists and engineers to positions within their laboratory on a short-term or continuing basis. This technique takes care of legal implications such as insurance and patent rights.

RECOMMENDATION NO. 9: The Office of Science and Technology is urged to initiate the endorsement, clearance and issuance of the following Government-wide policy:

> *Unique, unusual, and expensive-to-duplicate facilities at Federal laboratories and federally-supported research centers should be made available to the national scientific community to the maximum extent practical without serious detriment to laboratory missions, especially to qualified academic scientists and engineers who would otherwise not have access to such facilities. Criteria for such use should be the scientific merit of the proposed experiment, its relation to the agency research mission, and its contribution to related national educational needs.*
>
> *When such facilities are used by academic scientists and engineers, the costs incurred by the laboratory or center for the operation of its unique or unusual research facilities should generally be funded by the agency responsible for the operation of that facility, except for any significant incremental costs incurred in support of research not directly related to the agency's mission. The research costs incurred at the experimenter's home institution and significant costs for specialized equipment fabricated*

at the center primarily for use by the particular experimenter should normally be borne by the granting agency, the home institution, and/or other sponsoring organization, but may, when deemed sufficiently related or useful to the host agency's responsibility, be borne by the agency responsible for operation of the center.

IMPLEMENTING A GOVERNMENT-WIDE POLICY

In promulgating the foregoing policy:

1. Authority for negotiations and decisions as to the use of Federal facilities by outside groups should be delegated to local laboratory directors to the maximum extent possible, with such actions remaining as flexible and informal as responsible practice would dictate. Directors should be encouraged to make appropriate use of advisory groups in formulating their decisions.

2. Application of the policy is not meant to take priority over accomplishment of the agency's mission.

3. Where programs for non-Government use of Federal facilities are appropriately expanded, department and agency officials should be prepared to assist laboratory directors obtain correspondingly increased staff and budget allocations.

4. To the extent practicable, Federal laboratory officials should have a prior agreement executed by non-Government users absolving the Federal agency of liability in case of personal injury, death, and failure or damage to experiments or equipment.

5. It should be indicated that reciprocity in the use of equipment is equally desirable on the part of academic institutions.

The Executive Office of the President, through the Office of Science and Technology, should establish a mechanism for periodic follow-up concerning implementation of this policy. Such follow-up should determine the general level of activity involving non-Government use of unique facilities and also record successful and particularly noteworthy experiences.[1]

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[1] The subject of increased non-Federal use of Government facilities is treated at greater length in the Committee on Federal Laboratories' report, "An Evaluation of the National Science Board's Proposal for Increased Use of Government Facilities," dated May 15, 1967.

SUMMARY

Under the auspices of the Committee on Federal Laboratories, the task force interviewed the management of 75 Federal research and development installations and one Federal Contract Research Center. Frank and informative discussions took place on a wide range of subjects, primarily involving current activities, needs, and constraints to effective education and training. As a group, the laboratories visited are more heavily oriented toward research than is the total Federal R&D effort.

The nature and extent of the laboratories' relationships with the academic community are directly associated with the extent and effectiveness of their education and training programs. Joint research activities, personnel and equipment interchange, and employee training activities are the principal avenues of interaction with universities. Effective university-laboratory relationships are more likely to be developed by laboratories (1) oriented more heavily toward research, (2) located in what could be termed a "rich" academic environment, and (3) having only a few (or no) other laboratories doing somewhat similar work in the same geographical area. Although much significant research can be and has been developed without close university ties, a good working relationship with universities is a definite plus to the Federal laboratory.

Federal laboratories continue to have a significant effect on university curricula.

Although universities generally cooperate with Federal laboratories, there is some university withdrawal from previous levels of cooperation in some laboratory educational efforts such as after-hours courses, residency requirements and thesis research in Federal laboratories.

Interaction between Federal scientists and their non-Federal colleagues is essential if Federal research is to continue to be dynamic. Most formal mechanisms that provide for this through the medium of flow-through programs are heavily one-sided; non-Federal scientists and engineers move into the Federal structure on a temporary basis to a far greater extent than Federal professionals move into non-Federal research centers. Devices that permit flow-in of non-Federal scientists and engineers include WAE appointments, contractual arrangements, cooperative programs, NAS-NRC postdoctorals, and several research associate/fellowship/visiting programs specific to a few organizations through special authorization. Formal flow-out mechanisms are scarce and limited in magnitude. Flow-through programs of both types should be expanded; a Government-wide visiting program would be especially desirable.

There has been much sharing of equipment and facilities between universities and Federal laboratories.

There is widespread satisfaction with the Government Employees' Training Act, despite relatively minor difficulties with some of its restrictions. The Federal laboratories have contributed significantly to the Nation's total advanced training and education activities through the various provisions of this Act. Although there are many elements of self-interest on the part of Federal laboratories in participating in these activities, as is quite natural and proper, considerable benefit also has accrued to universities, students, other non-Federal institutions, and to science and engineering in general.

Federal R&D laboratories have engaged in a variety of activities designed to advance the "state of the art" in science and engineering, stimulate interest on the part of young people in science and engineering as a career, and fulfill their social roles as members of the community.

Many forces operate to place restraints on laboratory management in its efforts to provide optimum levels of training and education. Among these are manpower and money. Of equal concern are difficulties with higher headquarters and others in superior positions: administrative red tape and delay, unduly restrictive controls on details of local laboratory management, narrow interpretations, and restriction on travel (particularly for attending scientific and technical meetings). Some instances were found where an organization at the bureau level has effectively acted as a buffer to prevent at least some of this frustrating atmosphere from interferring with its field laboratories.

Despite many differences in the functions of universities and government laboratories in the two countries, it is of interest to note similarity between many of the major recommendations in this report and those contained in the Report of the Working Party on Liaison Between Universities and Government Research Establishments, published in the United Kingdom in March 1967.[1] Conclusions and recommendations of the British report, chaired by Sir Gordon Sutherland, point out the need for closer staff relationships between universities and government laboratories, more cooperative research projects, and more extensive movement of professionals between university and government laboratory positions--conclusions which are also reached in this report of the Committee on Federal Laboratories.

In general the Federal R&D laboratories have made extensive use of the many techniques available to work with universities and others in providing education and training opportunities for laboratory employees and for many individuals and institutions outside the Federal government. More could be done if additional techniques were made available and if some current restrictions were removed to permit more effective use of existing techniques. To these ends, nine general recommendations are made. These are listed immediately following the foreword in the front of this report.

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[1] Council for Scientific Policy, Report of the Working Party on Liaison Between Universities and Government Research Establishments, Her Majesty's Stationery Office, London, March 1967.

LIST OF LABORATORIES VISITED

DEPARTMENT OF AGRICULTURE

Agricultural Research Service

ARS Beltsville Research Laboratories
Beltsville, Maryland

Eastern Regional Research Laboratory
Wyndmoor, Pennsylvania

National Animal Disease Laboratory
Ames, Iowa

Northern Regional Research Laboratory
Peoria, Illinois

Western Regional Research Laboratory
Albany, California

Forest Service

Forest Products Laboratory
Madison, Wisconsin

Pacific Southwest Forest and Range Experiment Station
Berkeley, California

DEPARTMENT OF COMMERCE

Environmental Science Services Administration

Environmental Science Services Administration (ESSA)
Washington, D.C.

Environmental Science Services Administration (ESSA-Boulder)
Boulder, Colorado

National Bureau of Standards

Boulder Laboratories
Boulder, Colorado

Joint Institute for Laboratory Astrophysics
Boulder, Colorado

National Bureau of Standards
Gaithersburg, Maryland

DEPARTMENT OF DEFENSE

Army

Ballistic Research Laboratories
Aberdeen Proving Ground, Maryland

*Coating and Chemical Laboratory
Aberdeen Proving Ground, Maryland

Development and Proof Services
Aberdeen Proving Ground, Maryland

Frankford Arsenal
Philadelphia, Pennsylvania

Harry Diamond Laboratories
Washington, D.C.

Human Engineering Laboratories
Aberdeen Proving Ground, Maryland

Medical Research and Nutrition Laboratory
Denver, Colorado

Natick Laboratories
Natick, Massachusetts

Research and Development Kirectorate
Redstone Arsenal, Alabama

Research Institute of Environmental Medicine
Natick, Massachusetts

*Surgical Research Unit
Ft. Sam Houston, Texas

Walter Reed Army Institute of Research
Washington, D.C.

Navy

Air Development Center
Johnsville, Pennsylvania

Air Engineering Center
Philadelphia, Pennsylvania

Naval Ship R&D Center
Carderock, Maryland

*Flagstaff Station of Naval Observatory
Flagstaff, Arizona

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* Laboratory has less than 50 professional personnel.

Navy Cont'd

Marine Engineering Laboratory
Annapolis, Maryland

Naval Ordnance Laboratory
White Oak, Maryland

Naval Research Laboratory
Washington, D.C.

*Office of Naval Research Field Office
San Francisco, California

Ordnance Test Station
China Lake, California

Radiological Defense Laboratory
San Francisco, California

Ship Engineering Center
Philadelphia, Pennsylvania

Air Force

Aeropropulsion Laboratory
Wright-Patterson AFB, Ohio

Aerospace Research Laboratories
Wright-Patterson AFB, Ohio

Avionics Laboratory
Wright-Patterson AFB, Ohio

*Epidemiological Laboratory
Lackland AFB, Texas

*Flagstaff Branch of Aeronautical Chart and Information Center
Flagstaff, Arizona

Flight Dynamics Laboratory
Wright-Patterson AFB, Ohio

Flight Test Center
Edwards AFB, California

Materials Laboratory
Wright-Patterson AFB, Ohio

Rocket Propulsion Laboratory
Edwards AFB, California

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* Laboratory has less than 50 professional personnel.

Air Force Cont'd

School of Aerospace Medicine
Brooks AFB, Texas

6570th Aerospace Medical Research Laboratory
Wright-Patterson AFB, Ohio

6570th Personnel Research Laboratory
Lackland AFB, Texas

Systems Engineering Group
Wright-Patterson AFB, Ohio

Wilford Hall Hospital
San Antonio, Texas

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Food and Drug Administration

Bureau of Medicine
Washington, D.C.

Bureau of Science
Washington, D.C.

Public Health Service

National Center for Urban Development
Cincinnati, Ohio

National Institutes of Health
Washington, D.C.

DEPARTMENT OF THE INTERIOR

Bureau of Mines

College Park Metallurgy Research Center
College Park, Maryland

Denver Mining Research Center
Denver, Colorado

Explosives Research Center
Pittsburgh, Pennsylvania

*Health and Safety Research and Testing Center
Pittsburgh, Pennsylvania

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* Laboratory has less than 50 professional personnel.

Bureau of Mines Cont'd

*Marine Minerals Technology Center
Tiberon, California

Pittsburgh Coal Research Center
Pittsburgh, Pennsylvania

*Pittsburgh Mining Research Center
Pittsburgh, Pennsylvania

Bureau of Reclamation

Engineering Laboratory
Denver, Colorado

Federal Water Pollution Control Administration

Ohio Basin Region
Cincinnati, Ohio

Fish and Wildlife

*Biological Laboratory
Palo Alto, California

*Icthyological Laboratory
Palo Alto, California

*Marine Laboratory
Tiberon, California

Geological Survey

*Astrogeology Branch
Flagstaff Arizona

Geological Survey Pacific Coast Center
Menlo Park, California

Geological Survey Rocky Mountain Center
Denver, Colorado

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Ames Research Center
Moffett Field, California

Electronics Research Center
Cambridge, Massachusetts

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* Laboratory has less than 50 professional personnel.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Cont'd

Flight Research Center
Edwards, California

George C. Marshall Space Flight Center
Huntsville, Alabama

Goddard Space Flight Center
Greenbelt, Maryland

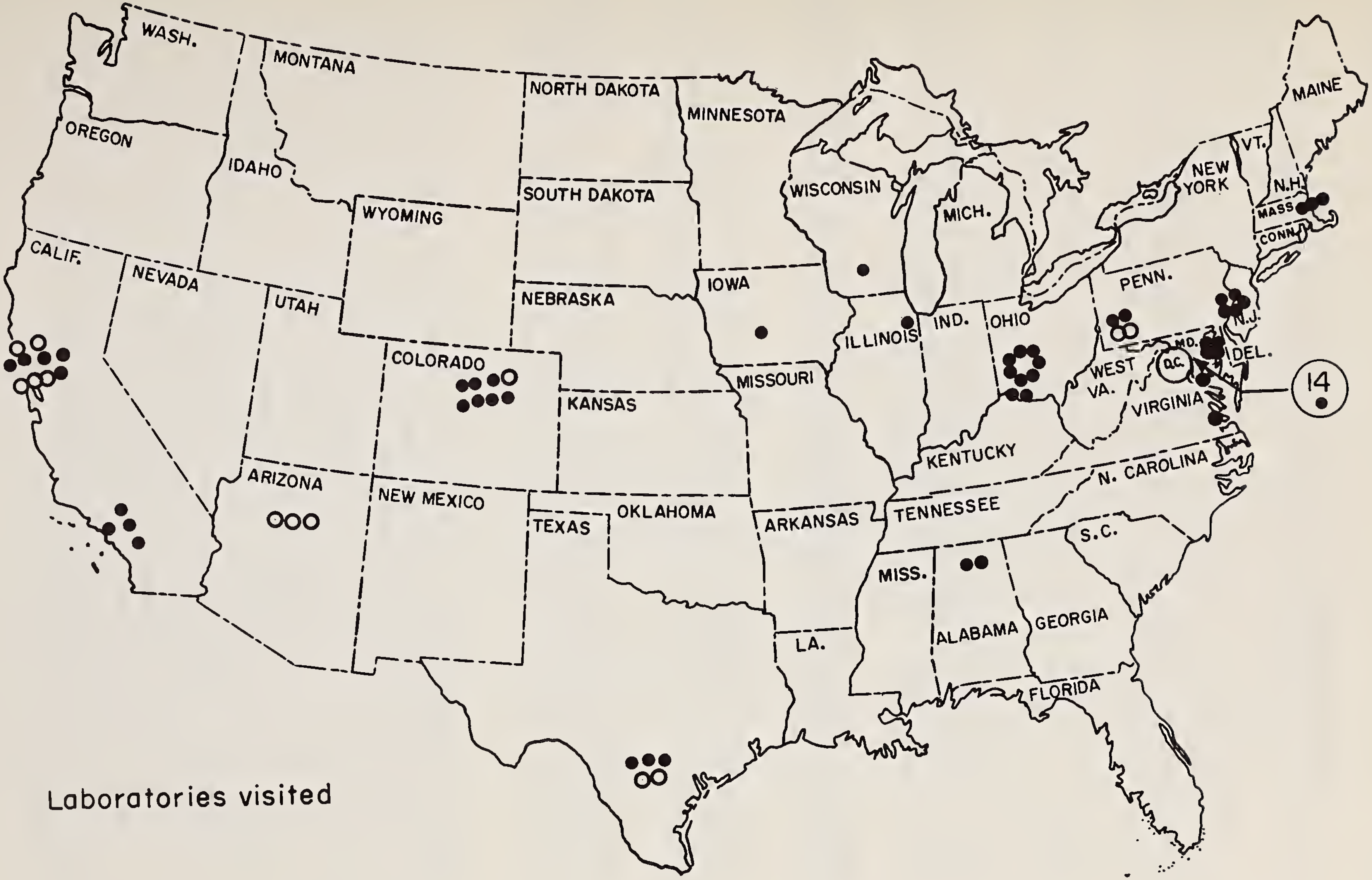
Langley Research Center
Langley Field, Virginia

VETERANS ADMINISTRATION

Veterans Administration
Washington, D.C.

NON-GOVERNMENT

National Center for Atmospheric Research
Boulder, Colorado



Laboratories visited

- ● Laboratories having 50 or more professional personnel
- ○ Laboratories having less than 50 professional personnel

CHARACTERISTICS OF THE LABORATORY SAMPLE

The major criteria used in determining the laboratories to be included in the study are shown below. The first six criteria are the same as the six dimensions used to characterize and analyze laboratories as described in the body of the report and as tabulated in Appendix C.

1. Agency. The study included laboratories, generally at the bureau level, from all major departments and agencies having significant R&D activities.

2. Size. The range extended from small laboratories having considerably less than 50 professional personnel to large laboratory complexes employing more than 1,000 professional R&D personnel.

3. Nature of Work. The range included laboratories oriented toward basic and applied research, development, and testing and evaluation--singly or in combination.

4. Geographical Location. An attempt was made to obtain broad geographical coverage of the continental United States, within the limitations imposed by the current location of Federal R&D laboratories.

5. Academic Environment. Whether or not a laboratory is geographically close to one or more universities was presumed to be an important factor. The study included laboratories located on a university campus and laboratories located 150 miles from the nearest university of any kind.

6. Laboratory Clustering. Sometimes a department establishes a complex of laboratories in one general location, with some similarity of work and interests among at least some of the laboratories (example: Wright-Patterson Air Force Base). In other instances two or more laboratories at one general location may find they have much in common, regardless of whether they belong to the same department (example: NASA and Army at Huntsville, Alabama). There may also be, at one general location, several laboratories with interests and work which coincide to some extent (example: some laboratories in the San Francisco area), or laboratories that have little if anything in common with other Federal laboratories in the area (example: Army Medical and Nutrition Laboratory in Denver). There are also Federal laboratories located far away from all other Federal laboratories (example; NOTS-China Lake, Forest Products Laboratory). All of the above situations were included in the sample of laboratories visited.

7. Discipline. A deliberate effort was made to include laboratories engaged in earth sciences, biomedical, behavioral and other life sciences, as well as the physical sciences and engineering.

8. Headquarters-Field. The installations visited were generally of the field type rather than headquarters. Twenty-four groups were interviewed within a 150 mile radius of Washington, D.C., as part of the pilot study to develop techniques and determine whether to extend the visits to more distant field laboratories.

9. Laboratory-University Relationships. Various situations where laboratory-university relationships appeared to be significantly different were identified and included to permit exploration of factors which link or fail to link the academic community and the Federal R&D community.

Tables 1 through 9 on the folowing pages indicate the sample characteristics of the laboratories visited by the task force.

TABLE 1 – AGENCIES REPRESENTED IN SAMPLE

Number of Laboratories		Size of Professional Staff		Agency
7		1,690		Department of Agriculture
	5		1,370	Agricultural Research Service
	2		320	Forest Service
5		3,190		Department of Commerce
	3		1,850	National Bureau of Standards
	2		1,340	Environmental Science Services Administration
37		13,440		Department of Defense
	12		4,020	Army
	11		6,030	Navy
	14		3,390	Air Force
4		4,590		Department of Health, Education & Welfare
	2		460	Food and Drug Administration
	2		4,130	Public Health Service
15		1,200		Department of the Interior
	7		328	Bureau of Mines
	3		12	Fish and Wildlife
	1		45	Bureau of Reclamation
	1		200	Water Pollution Control Administration
	3		615	Geological Survey
6		7,370		National Aeronautics and Space Administration
1		-		Veterans Administration
1		-		National Center for Atmospheric Research
76		31,480 plus		TOTAL

Visited : 62 laboratories meeting the criteria, with a total of 31,350 professional R&D personnel.
Visited : 13 installations not meeting the criteria, with a total of 130 professional R&D personnel.
Not Visited: 81 laboratories meeting the criteria, with a total of 26,350 professional R&D personnel.

TABLE – 2 DISCIPLINES REPRESENTED IN SAMPLE

Number of laboratories in which a significant percent of R&D staff is involved in the indicated discipline	Discipline
54	Engineering (electrical, electronic, mechanical, civil, sanitary, aeronautical, textile, metallurgical, naval architectural, industrial)
42	Physical Sciences (physics, geophysics, astrophysics, hydrology, meteorology, oceanography)
34	Chemistry (biochemistry, textile, plant cell, food technology)
24	Biology (microbiology, botany, biophysics, plant physiology)
13	Bio-Medical (medicine, dentistry, veterinary, pathology, toxicology, physiology, pharmacology, psychiatry, bacteriology)
11	Mathematics
9	Behavioral (psychology, human engineering, clinical psychology)
5	Geology
5	Forestry-Agronomy

TABLE 3 – SIZE OF LABORATORY

Number of Laboratories	Approximate Size of Professional Staff	Description
20	2 to 50	Very Small
11	80 to 174	Small
17	192 to 300	Medium
13	339 to 600	Large
15	715 and above	Very Large

TABLE 4 – NATURE OF WORK

Number of Laboratories	Primary Emphasis of Lab's Work*
24	Research
29	Research & Development
13	Development
10	Testing & Evaluation

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* Based on evaluation by the task force.

TABLE 5 – STATES REPRESENTED IN SAMPLE

Number of Laboratories	State
2	Alabama
3	Arizona
14	California
8	Colorado
14	D.C. Metropolitan Area
1	Illinois
1	Iowa
5	Maryland
3	Massachusetts
9	Ohio
9	Pennsylvania
5	Texas
1	Virginia
1	Wisconsin

TABLE 6 – GEOGRAPHICAL AREAS

Number of Laboratories	Geographical Area
14	Metropolitan D.C.
29	Eastern
16	Rocky Mountain-Midwest-Southwest
17	Western

TABLE 7 – CITIES WHERE ALL OR NEARLY ALL FEDERAL LABORATORIES WERE VISITED

Denver-Boulder, Colorado
Flagstaff, Arizona
Philadelphia, Pennsylvania
Pittsburgh, Pennsylvania
San Antonio, Texas
San Francisco, California
Wright-Patterson AFB, Ohio

TABLE 8 – ACADEMIC ENVIRONMENT

Number of Laboratories	Laboratory location relative to appropriate universities*
23	"Rich" or "Close" environment
20	"Medium" or "Average" environment
19	"Isolated" or "Distant" environment
14	Metropolitan D.C.

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* Based on evaluation by the task force.

TABLE 9 – COMPARISON OF DOD WITH NON-DOD LABORATORIES IN RESPECT TO SIZE AND NATURE OF WORK

(excludes 4 laboratories not classifiable to this table)

DOD

Size of R&D Staff	Number of Laboratories Primarily Engaged In: Research	R&D	Development	Testing	Total	%
2 to 50	4	3	0	1	8	22
80 to 174	3	1	1	2	7	19
192 to 300	1	3	0	1	5	14
339 to 600	1	4	2	2	9	25
715 & above	1	4	1	1	7	19
TOTAL	10	15	4	7	36	
%	28	42	11	19		100

NON-DOD

Size of R&D Staff	Number of Laboratories Primarily Engaged In: Research	R&D	Development	Testing	Total	%
2 to 50	4	1	5	1	11	30
80 to 174	0	2	2	0	4	11
192 to 300	4	5	1	1	11	30
339 to 600	2	2	0	0	4	11
715 & above	2	3	0	1	6	17
TOTAL	12	13	8	3	36	
%	33	36	22	8		100

STATISTICAL TABLES

The six dimensions used in this analysis are defined and discussed in the body of the report and in Appendix B. They are: agency, size of laboratory, nature of work, geographical location, academic environment, and laboratory clustering. The five subject areas analyzed are also discussed in the body of the report. They are: university relationships, employee training activities, personnel interchange, equipment interchange, and other (primarily non-university) relationships.

Each of the laboratories was placed in the appropriate category for each of the six dimensions, according to the best judgment of the task force based on the information available. Similarly, each laboratory was placed in the most appropriate group for each of the five subject areas. There was no forced distribution to provide equal-size groups; each laboratory was simply placed in the category judged most appropriate when compared with other laboratories visited. Following are the descriptive titles of each category, together with the corresponding column headings used in the data tables in this appendix.

Very High - clearly positive

High - generally positive

Mixed - mixed; moderate; doubtful

Neutral - not significant

Low - generally negative

In general Federal R&D laboratories were considered to be on the positive side with respect to the major subjects covered in this report. As can be seen from the series of tables which follow, between 50 percent and 57 percent of all laboratories visited were ranked in clearly positive groups (Very High and High), compared to 21 percent to 31 percent ranked in more negative groups (Neutral and Low).

Statistics are based on 72 laboratories rather than the total of 76 laboratories visited. Four laboratories are excluded since they cannot appropriately be analyzed on the six dimensions (one is a non-government installation and three are headquarters offices representing a large number of field laboratories).

TABLE 1 – UNIVERSITY RELATIONSHIPS

Agency

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DOD	6	17	11	30	8	22	6	17	5	14	36	100
Non-DOD	16	44	5	14	5	14	7	19	3	8	36	100
Total	22	31	16	22	13	18	13	18	8	11	72	100

Size of Laboratory

No. R&D Professional Personnel	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2 to 50	6	32	3	16	3	16	2	10	5	26	19	100
80 to 174	2	18	3	27	2	18	4	36	–	–	11	100
192 to 300	4	25	3	19	4	25	4	25	1	6	16	100
339 to 600	4	31	2	15	3	23	3	23	1	8	13	100
715 and up	6	46	5	38	1	8	–	–	1	8	13	100

Nature of Work

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Heavily Research	7	88	1	12	–	–	–	–	–	–	8	100
Research	9	64	4	29	1	7	–	–	–	–	14	100
R&D	3	23	2	15	3	23	4	31	1	8	13	100
D&R	3	20	5	33	4	27	2	13	1	7	15	100
Development	–	–	2	17	4	33	4	33	2	17	12	100
Testing	–	–	2	20	1	10	3	30	4	40	10	100

Geographical Location

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	2	17	3	25	2	17	–	–	12	100
Eastern	5	17	8	27	6	21	6	21	4	14	29	100
Mid-U.S.	5	33	2	13	3	20	3	20	2	13	15	100
Western	7	44	4	25	1	6	2	12	2	12	16	100

Academic Environment

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	2	17	3	25	2	17	–	–	12	100
Close	10	48	5	24	2	9	2	9	2	9	21	100
Average	3	15	6	30	4	20	4	20	3	15	20	100
Distant	4	21	3	16	4	21	5	26	3	16	19	100

Laboratory Clustering

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Many	1	6	3	18	5	29	5	29	3	18	17	100
Average	3	18	4	23	3	18	5	29	2	12	17	100
Few	13	50	5	19	4	15	1	4	3	12	26	100
Single	5	42	4	33	1	8	2	17	–	–	12	100

TABLE 2 – EMPLOYEE TRAINING ACTIVITIES

Agency

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DOD	9	25	13	36	5	14	6	17	3	8	36	100
Non-DOD	6	17	12	33	9	25	7	20	2	5	36	100
Total	15	21	25	35	14	19	13	18	5	7	72	100

Size of Laboratory

No. R&D Professional Personnel	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2 to 50	–	–	3	16	4	21	9	47	3	16	19	100
80 to 174	2	18	4	36	4	36	1	9	–	–	11	100
192 to 300	1	6	8	50	5	31	2	13	–	–	16	100
339 to 600	4	31	6	46	1	8	–	–	2	15	13	100
715 and up	8	61	4	31	–	–	1	8	–	–	13	100

Nature of Work

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Heavily Research	1	12	2	25	1	12	4	50	–	–	8	100
Research	4	29	5	36	2	14	3	21	–	–	14	100
R&D	3	23	4	31	5	38	1	8	–	–	13	100
D&R	5	33	7	47	–	–	2	13	1	7	15	100
Development	2	17	4	33	4	33	1	8	1	8	12	100
Testing	–	–	3	30	2	20	2	20	3	30	10	100

Geographical Location

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	4	33	3	25	–	–	–	–	12	100
Eastern	6	21	11	38	6	21	5	17	1	3	29	100
Mid-U.S.	2	13	4	27	3	20	4	27	2	13	15	100
Western	2	12	6	38	2	12	4	25	2	12	16	100

Academic Environment

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	4	33	3	25	–	–	–	–	12	100
Close	5	24	6	28	5	24	4	19	1	5	21	100
Average	3	15	10	50	4	20	2	10	1	5	20	100
Distant	2	10	5	26	2	10	7	37	3	16	19	100

Laboratory Clustering

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Many	1	6	5	29	4	24	5	29	2	12	17	100
Average	4	24	6	35	4	24	3	18	–	–	17	100
Few	5	19	10	38	5	19	3	12	3	12	26	100
Single	5	42	4	33	1	8	2	17	–	–	12	100

TABLE 3 – PERSONNEL INTERCHANGE

Agency

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
DOD	5	14	11	30	10	28	10	28	36	100
Non-DOD	11	31	9	25	11	31	5	14	36	100
Total	16	22	20	28	21	29	15	21	72	100

Size of Laboratory

No. R&D Professional Personnel	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
2 to 50	6	32	2	10	5	26	6	32	19	100
80 to 174	1	9	3	27	3	27	4	36	11	100
192 to 300	3	19	4	25	6	37	3	19	16	100
339 to 600	–	–	7	54	5	38	1	8	13	100
715 and up	6	46	4	31	2	15	1	8	13	100

Nature of Work

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Heavily Research	8	100	–	–	–	–	–	–	8	100
Research	5	36	8	57	1	7	–	–	14	100
R&D	2	15	2	15	7	53	2	15	13	100
D&R	1	7	5	33	5	33	4	27	15	100
Development	–	–	4	33	4	33	4	33	12	100
Testing	–	–	1	10	4	40	5	50	10	100

Geographical Location

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	1	8	5	42	1	8	12	100
Eastern	3	10	12	42	7	24	7	24	29	100
Mid-U.S.	2	13	4	27	5	33	4	27	15	100
Western	6	37	3	19	4	25	3	19	16	100

Academic Environment

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	1	8	5	42	1	8	12	100
Close	6	29	9	43	4	19	2	9	21	100
Average	2	10	7	35	5	25	6	30	20	100
Distant	3	16	3	16	7	37	6	31	19	100

Laboratory Clustering

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Many	1	6	2	12	7	41	7	41	17	100
Average	1	6	8	47	4	23	4	23	17	100
Few	11	42	3	12	9	34	3	12	26	100
Single	3	25	7	58	1	8	1	8	12	100

TABLE 4 – EQUIPMENT INTERCHANGE

Agency

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DOD	4	11	9	25	7	19	11	31	5	14	36	100
Non-DOD	11	31	15	42	4	11	4	11	2	6	36	100
Total	15	21	24	33	11	15	15	21	7	10	72	100

Size of Laboratory

No. R&D Professional Personnel	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2 to 50	4	21	8	42	1	5	4	21	2	11	19	100
80 to 174	1	9	5	46	2	18	-	-	3	27	11	100
192 to 300	5	31	4	25	3	19	3	19	1	6	16	100
339 to 600	2	15	3	23	1	8	6	46	1	8	13	100
715 and up	3	23	4	31	4	31	2	15	-	-	13	100

Nature of Work

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Heavily Research	5	63	1	12	1	12	1	12	-	-	8	100
Research	6	43	7	50	-	-	-	-	1	7	14	100
R&D	2	15	3	23	4	31	2	15	2	15	13	100
D&R	2	13	6	40	2	13	4	27	1	7	15	100
Development	-	-	6	50	2	17	3	25	1	8	12	100
Testing	-	-	1	10	2	20	5	50	2	20	10	100

Geographical Location

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	2	17	6	50	1	8	2	17	1	8	12	100
Eastern	3	10	10	35	7	24	8	28	1	3	29	100
Mid-U.S.	4	27	4	27	2	13	2	13	3	20	15	100
Western	6	38	4	25	1	6	3	19	2	12	16	100

Academic Environment

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	2	17	6	50	1	8	2	17	1	8	12	100
Close	7	33	7	33	1	5	6	29	-	-	21	100
Average	4	20	8	40	4	20	1	5	3	15	20	100
Distant	2	10	3	16	5	26	6	32	3	16	19	100

Laboratory Clustering

	Very High		High		Mixed		Neutral		Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Many	2	12	3	18	4	23	6	35	2	12	17	100
Average	2	12	6	35	3	18	4	23	2	12	17	100
Few	8	31	12	46	1	4	3	11	2	8	26	100
Single	3	25	3	25	3	25	2	17	1	8	12	100

TABLE 5 – OTHER (PRIMARILY NON-UNIVERSITY) RELATIONSHIPS

Agency

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
DOD	6	17	13	36	6	17	11	30	36	100
Non-DOD	10	28	12	33	5	14	9	25	36	100
Total	16	22	25	35	11	15	20	28	72	100

Size of Laboratory

No. R&D Professional Personnel	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
2 to 50	3	16	5	26	1	5	10	53	19	100
80 to 174	–	–	4	36	3	27	4	36	11	100
192 to 300	5	31	6	38	1	6	4	25	16	100
339 to 600	2	15	5	38	5	38	1	8	13	100
715 and up	6	46	5	38	1	8	1	8	13	100

Nature of Work

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Heavily Research	3	38	3	38	–	–	2	25	8	100
Research	6	43	4	29	3	21	1	7	14	100
R&D	–	–	6	46	4	31	3	23	13	100
D&R	4	27	7	47	2	13	2	13	15	100
Development	1	8	3	25	1	8	7	58	12	100
Testing	2	20	2	20	1	10	5	50	10	100

Geographical Location

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	2	17	3	25	2	17	12	100
Eastern	5	17	13	45	2	7	9	31	29	100
Mid-U.S.	2	13	3	20	5	33	5	33	15	100
Western	4	25	7	44	1	6	4	25	16	100

Academic Environment

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
D.C. Metrop.	5	42	2	17	3	25	2	17	12	100
Close	2	10	11	52	4	19	4	19	21	100
Average	5	25	8	40	2	10	5	25	20	100
Distant	4	21	4	21	2	11	9	47	19	100

Laboratory Clustering

	Very High		High		Mixed		Neutral or Low		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Many	–	–	8	47	3	18	6	35	17	100
Average	2	12	3	18	3	18	9	53	17	100
Few	12	46	8	31	3	12	3	12	26	100
Single	2	17	6	50	2	17	2	17	12	100

JOINT INSTITUTE FOR LABORATORY ASTROPHYSICS (NBS)

A Collaborative Effort of the National Bureau of Standards
and the University of Colorado

Nature of Joint Activities in Education and Research

The Joint Institute for Laboratory Astrophysics (JILA) was established in 1962 as a cooperative venture between the University of Colorado (CU) and the National Bureau of Standards (NBS). It is a center for advanced research, study and graduate education in astrophysics, atomic physics, aerodynamics and related fields. NBS scientists hold faculty appointments as professors adjoint or lecturers in the Physics and Astrophysics Department of the university. They supervise graduate students and take part in the Department's teaching program. Participating CU faculty members conduct their regular teaching duties and do collaborative research with NBS scientists in JILA.

Philosophic Justification for the Program

The NBS for over half-a-century has promoted the participation of its staff in education and other academic activities. The Bureau realizes that technical competence and research progress can be best maintained by continued contact with and participation in the activities of the institutions engaged in frontier research. Similarly universities gain from interaction with the NBS staff. A close working relationship opens opportunities to universities which would otherwise be unavailable to their staffs as well as their students. Simultaneously, the NBS also gains greatly from the stimulus of fresh, questioning graduate students and the continuing dialogue between its senior staff and their academic peers.

JILA - A Model for Government-University Relations and Interchange

Through a formal memorandum of understanding, JILA makes it possible for the NBS and the University of Colorado to collaborate intimately in the conduct of research, teaching, and other educational and research activities. This active partnership is often referred to as a model for government-university relations. JILA differs from other government-university programs in that members of the NBS staff (1) participate and vote with their academic counterparts on university committees; (2) teach both graduate and undergraduate students as part of their official duty working time (teaching is part of their official job assignments); and (3) work jointly with the university staff in exploiting a series of research opportunities in astrophysics and atomic physics. This endeavor leaves little question that the placement of a relatively small staff of top Federal scientists in a joint laboratory-university setting can dramatically increase the quality of research being produced.

In the five years since it was formed, JILA has attracted about 64 graduate students and 42 postdoctoral students to the University of Colorado campus. JILA, through its fellowship program, also brings 10 outstanding scientists each year from throughout the world to study and to do research of their own choosing for periods of up to a year. Thus far 58 visiting fellowships have been awarded. Numerous other leading scientists spend varying periods of time conferring with JILA scientists and lecturing at the University. The permanent staff of JILA is comprised of the Laboratory Astrophysics Division of the Bureau and CU faculty members of the Departments of Physics and Astrophysics, Chemistry, and Aerospace Engineering Sciences. They share a laboratory and office complex on the University of Colorado campus. The tenor of cooperation is such that equipment and personnel, including technical and administrative support staff, are fully shared, with the result that the Government side of the operation is relatively unhampered by the usual problems relating to the adequacy of ceilings and logistical support services. The NBS Laboratory Astrophysics Division's scientific staff is comprised almost entirely of senior staff members. They rely on the graduate and postdoctoral students associated with JILA for the research and laboratory assistance required to carry out dynamic theoretical and experimental programs.

In summary, JILA is a highly effective venture in joint research work and is characterized by an atmosphere that encourages lively interaction of thinking and ideas leading to an animated spirit in the conduct of basic research. To a large degree, this is made possible by the caliber of personnel making up the nucleus of its leadership, the informality of the organization, and the injection of an academic tone in its thinking and operations.

Additional information on the organizational structure and operations may be obtained from the Executive Officer, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado 80302.

GEOLOGICAL SURVEY USE OF "WHEN ACTUALLY EMPLOYED" (WAE) APPOINTMENTS

The President's Science Advisory Committee in November 1960 used the words "...we hold to the view that in the absence of special considerations a university is the best place for basic research, and we note that the separate (non-university) installations which do the best work are, as a rule, those which have a close and effective connection with academic centers; the Geological Survey in its intimate relation to academic geology is an excellent case in point." The nature of the Survey's relation to academic centers has been asked frequently since then.

The connections began with the founding of the Survey in 1879. Scholarly men with various academic backgrounds made up the original staff, and they shared a viewpoint expressed by John Wesley Powell to Congress in 1884 as follows: "Whenever the scientific works of the general government fall out of the control of scientific men . . . (it) at once becomes severed from the great body of scientific men: it no longer takes a proper part in the great work to be done, and it speedily decays in influence and value."

A key element in the relationship is the "when actually employed" (WAE) pay status: the individual usually holds a competitive appointment to the Geological Survey (USGS) but draws a salary only "when actually employed." Such a person is an integral part of the Civil Service merit system. His position is classified in accordance with normal Federal practices and the compensation he receives for his work is consonant with that of full-time employees doing similar work. Many WAE's also earn retirement benefits in proportion to the time they work for the Survey. In matters of ethics and conflicts of interest, all Survey employees must meet the same tests. WAE appointments have facilitated the movement of scientists between academic centers and the Survey since its earliest days.

There are usually about 150 faculty members from 75 different colleges and universities on the WAE roll of the Survey. Each year about 60 faculty men from 35 different universities participate actively in the Survey's research program. Not all men holding WAE status necessarily draw salaries from the Survey during any particular year, but their presence on the roll is important: for one thing, they constitute a ready-reserve of proved talent, which can be drawn upon as special program needs arise. The WAE cadre has been the base on which the Survey has expanded dramatically to meet the pressures of two world wars. The intensive research and exploration of the Colorado Plateau uranium deposits during and after World War II was manned to an important degree through the WAE roll. Perhaps more important is the intangible quality of "identification:" the men and the organization both derive stimulation, mutual support, and a sense of satisfaction from identifying themselves with a particular professional community. A number of eminent men identified themselves with the Geological Survey by accepting "honorary appointments" with the simple title of Geologist.

The mutual support derives from several factors. The earth is the geologist's laboratory, and he must view nature's experiments in the field as well as his own in the laboratory; the academic schedule dovetails nicely in most cases with the field season, and faculty men generally become available at the time when the Survey needs to man additional research teams. Under the WAE system, the seasonal swings in employment are handled with much less paper work than other employment or separation actions--it involves less work to put the faculty man on the rolls ready for work than to process a leave slip for a full-time employee!

The faculty man has access, as a member of the Survey, to a wide variety of geologic skills and technical facilities, and the Survey has nationwide access to a greater variety of special talents on an intermittent basis than it can maintain on its staff on a full-time basis. Outstanding geographers and cartographers have also been brought into the Survey's design and production of the National Atlas of the United States through this mechanism.

When a faculty man participates as a WAE employee in the Survey community, he participates not only in intellectual interchanges in connection with the research but also in having a part, from time to time, as appropriate, in planning and programming, and in influencing the course of Survey development. Rarely does this call for formal consultation or organized sessions: generally the counsel or reaction is sought in the same informal and personal way that the opinions of full-time employees are sought. No distinction between full-time and part-time concern for Survey progress is necessary, and its absence promotes a sense of community solidarity.

A special segment of the professional community illustrates the relation between the U.S. Geological Survey and higher education. Between 1900 and 1962, a total of 103 men were members of the Section of Geology of the National Academy of Sciences. Of these, 63 men (63 percent) have held appointments in the USGS, and 47 (47 percent) of the total have been both Survey men and members of college and university faculties. The Section membership in 1962 totaled 33, of whom 9 (27 percent) were Survey career men and 17 (51 percent) have combined teaching and Survey careers.

At least 180 professional geologists who work or have worked in the Geologic Division are faculty members at 85 different colleges or universities. There are at present about 800 geologists in the Geologic Division, and 250 schools granting undergraduate and graduate degrees in the geological sciences, therefore a number equivalent to over one-fifth of the present complement is engaged in teaching at one-third of the career related colleges and universities. Many USGS geologists become full-time teachers, without giving up their appointments at the Geological Survey; they simply move from a full-time status to a WAE status--and some move back again. Many analysts of the conduct of research and development in the United States have urged that means be devised to increase "fluidity of movement" of scientists and engineers between Federal research establishments and the academic and not-for-profit centers. The WAE mechanism has for a long time provided this desired fluidity in the fields related to the Geological Survey's program.

Between the faculty men who feel a close tie with the Survey, and the Survey men who feel similarly about the academic community, the Survey is well known on many campuses. Research papers and "geologic case histories" in the Survey's series of publications are major aids to education that introduce the Geological Survey to prospective geologists. Formalized recruiting is not required to apprise students of Survey activities. Seasonal employment, especially in summer field work, gives students a chance to learn by being a productive part of a going research program. Each year, the Survey provides such employment to over 200 students from about 60 universities. Well over half of these students became interested in Survey work through WAE faculty men.

Students make up the fastest changing part of the WAE roster. The WAE mechanism helps them to continue with their Survey research project, or undertake new work appropriate to their surroundings, and "earn while they learn." The Survey loses few of the geologists that it encourages and supports in this way. Out of the present complement of about 800 geologists in the Geologic Division, at least 100 are known to have used the results of their Survey research work for Ph.D. dissertations.

Survey people assist schools in a variety of ways. Student research is stimulated and assisted by professional counsel and advice, by field review of especially difficult parts of research problems, and by help with the literature. Those who wish to build up college and university collections and gather specimens for use in lectures and laboratories can usually get valuable information and help from USGS publications and from local Survey people. Some local school libraries regularly receive periodicals as soon as they have been through a Survey office, and many have received sizable personal collections of books and journals. With the growth in recent years of interest in courses in earth sciences and geological sciences, Survey personnel have repeatedly been called on to help in devising or revising a curriculum, or to consult in the selection of faculty. Survey scientists serve on numerous university advisory committees, for example, Harvard, Princeton, Yale, Stanford, M.I.T. The Survey constitutes a dependable reservoir of able teachers, which is frequently looked to as a source of temporary replacements for college and university faculties. Several years ago one eminent university recruited three full professors, including a new department head, from the Survey in one fell swoop.

The U.S. Geological Survey is not the only Federal agency to use the WAE mechanism, but the Survey appears to make, relative to its size, the most use of it and to use this mechanism deliberately as part of its personnel policy in program management and manpower management. It is a simple mechanism permitting great flexibility; it adapts equally well to the needs of the young student at the pre-professional level, to mature professional personnel, and to the senior citizen; it can provide full-time employment for short periods, occasional employment over long periods, or whatever combination the Survey and the individual agree is desirable for the program. Of all the ways the Survey maintains its ties with the institutions of higher education, the WAE mechanism is probably the most important. Other agencies might adapt the WAE mechanism to their needs, using it in many cases to broaden and strengthen their manpower base and build close, continuing ties with the academic community.

THE VIRGINIA ASSOCIATED RESEARCH CENTER (NASA)

The Virginia Associated Research Center (VARC), established by the 1962 General Assembly of Virginia, is a cooperative venture of the College of William and Mary, the University of Virginia, Virginia Polytechnic Institute, and the Medical College of Virginia. The overall administration of the Center is the responsibility of the College of William and Mary, in nearby Williamsburg. The Center has three major functions:

1. To manage and operate NASA's Space Radiation Effects Laboratory (SREL), located at the Langley Research Center;

2. To develop a research program in which qualified institutions of higher learning and other research organizations may use the Laboratory;

3. To arrange for a coordinated program of resident graduate instruction under the joint sponsorship of the participating institutions.

VARC became operational with its research programs in early 1966, and it is still developing its faculty and instructional programs. The full impact of its program cannot yet be assessed.

Essential to the concept of VARC was an agreement between NASA and the State of Virginia. Under terms of this agreement, the facilities of SREL, primarily a 600 mev synchrocyclotron and a 10 mev linear accelerator, are shared by NASA and the cooperating universities in the performance of applied research in radiation effects and basic research in nuclear physics and related disciplines. Under the agreement, the research facilities of the Langley Research Center are made available for the research activities of an educational program beyond the scope of the SREL intermediate energy physics program. The proximity of VARC to the $250 million NASA laboratories at the Langley Research Center will significantly extend the opportunities for research under the VARC program to the fields of aerospace, aeronautics and other advanced technological fields. The facilities of NASA and the experience and capabilities of the VARC educational institutions have been combined to build a unique graduate education center.

Background

Higher education needs in the Hampton Roads area (comprising the cities of Norfolk, Newport News, Virginia Beach, Portsmouth, Hampton, Chesapeake, together with surrounding communities) have increased with the growth of this area as a major scientific and technological center on the East Coast. Long the site of extensive military installations, this urban seaport complex now has a population of over 900,000. With the advance of the national aeronautics and space program, it has become an important center of new evolving technology. In Table 1 are listed the local colleges and technological activities supported by local Federal and industrial organizations.

TABLE 1 - COLLEGIATE INSTITUTIONS AND SIGNIFICANT TECHNOLOGICAL ACTIVITIES IN THE HAMPTON ROADS AREA

Institutions of Higher Learning

1. College of William and Mary (Williamsburg)
2. Old Dominion College (Norfolk)
3. Virginia State College (Norfolk)
4. Frederick College (Portsmouth)
5. Hampton Institute (Hampton)
6. Christopher Newport College (Newport News)
7. Virginia Wesleyan College (Virginia Beach)

Technological Research and Development

1. Aerospace Research and Development
2. Ordnance Research and Development
3. Transportation Research and Development
4. Underwater Explosives Research
5. Synthetic Fibers
6. Electronics
7. Training Devices
8. Oceanography

Other Engineering Activities

1. Shipbuilding and Repair
2. Naval Mine Engineering
3. Air Force Logistics and Operations
4. Transportation Engineering
5. Petroleum Refining
6. Materials Processing

The seven local colleges are wholly or largely undergraduate institutions, with no extensive graduate programs in science and engineering. Recent manpower surveys emphasize a continuing shortage of trained scientific and technological personnel. The purpose of VARC is to meet the area's need for programs to increase its supply of technological manpower, and to serve its continuing educational and research demands.

APPENDIX F

The largest advanced technological activity in Hampton Roads area is the Langley Research Center's program of aerospace research. Langley does research and development which provide fundamental scientific information and basic engineering data for the development of future spacecraft and aircraft. The Center faces a continuing need for enlarging and upgrading its sizable technological staff in highly competitive science and engineering fields.

As with most technological specialists, candidates for employment at the Langley Research Center value the opportunity for advanced education leading to graduate degrees. This has also been an important factor for Langley in maintaining and upgrading the technological proficiency of its permanent staff.

The VARC program is designed to meet the long-range graduate education needs of the Hampton Roads area. Simultaneously, it is to remain sensitive to the immediate and specific needs of the Langley Research Center. Langley's requirements for an intensified research program, and for improved graduate training opportunities, served as the initial focal point of VARC activities. These activities, in turn will provide increased educational opportunities to other public and private installations in the region.

Research and Instructional Programs

Applied Research in Space Radiation. The initial research facility of VARC is the NASA Space Radiation Effects Laboratory, containing a 600 mev synchrocyclotron and a linear electron accelerator in the 10 mev range. Its primary function is to simulate the radiological conditions of outer space, in order to test and appraise structural, shielding, electronic and other materials and equipment used in the construction of space vehicles.

There are specific and well-defined needs for this kind of scientific and engineering data in the development of advanced space research. The Langley Research Center will reserve a sufficient portion of the facility's available capacity to carry out its program. The remaining time is made available for academic research.

Basic Research. While the initial activities of VARC have been centered on the priority needs of space technology, the sponsoring institutions and their contractual partner, NASA, are committed to the development of advanced research opportunities in broad areas of science and engineering.

The design and capacity of SREL exceeds the present requirements of applied research in radiation effects on materials and equipment. Accordingly, the total research program will promote the facility's potential in related areas, including--but not limited to--intermediate energy nuclear physics, chemistry, metallurgy, biology, and medicine.

Associated with these studies is the development of new experimental techniques, as well as the design and fabrication of instruments, equipment, computers, and other supporting facilities for research.

VARC's policies encourage not only breadth of research activity, but wide participation as well. Through cooperative programming, research opportunities are extended to the scientific staffs of the sponsoring institutions and to other qualified scientists and research enterprises.

Graduate Training for Resident Credit. The research activities at VARC are expected to generate the requisite conditions for the development of organized instructional programs. The full-time professional staff of SREL are scientists with specialties in physics, radiobiology, and engineering. They hold appointments to the faculties of the cooperating institutions. Scientists in many specialties visit the VARC facilities for extended periods of time, setting up, monitoring, and otherwise participating in research projects.

A Director of Instruction, coordinating with the cooperating institutions, utilizes the services of research personnel in the teaching of graduate courses and the supervision of graduate theses. As the cooperating institutions develop full-time faculties in major program areas, VARC operates as a resident center for graduate instruction and research, awarding credit towards masters and doctoral degrees, to be conferred locally by the cooperating institutions.

Program Development. The initial demand for graduate programs, like the research program, arises from the needs of NASA for improved opportunities in continuing education for their technological staff.

There will be a transitional phase during which the buildup of resident programs at VARC will parallel, and then supplant, the current extension programs at Langley sponsored by the member institutions.

Priorities for program development are determined by the sponsoring institutions.

Program Areas. In Table 2 (Items A and B) are listed the current extension and resident graduate programs available through the Langley Research Center. With the development of VARC, these programs will be transferred to VARC facilities, and augmented as indicated under Item C.

Particular degree offerings will remain identified with particular institutions, although cooperative agreements are worked out between the cooperating institutions for interchange of faculty and transfer of credits. This ready application of credits from any cooperating institution to the one in which the student is a candidate for a degree (the so-called "commutation" principle), is an important feature of VARC.

TABLE 2 - GRADUATE DEGREE CREDIT PROGRAMS AT LANGLEY RESEARCH CENTER OFFERED BY VARC COOPERATING INSTITUTIONS

A. Current Programs Through Extension

(In cooperation with U. of Virginia and V.P.I.)

Masters Programs	Doctoral Programs
Engineering Physics	Aerospace Engineering
Mechanical Engineering	Engineering Mechanics
Metallurgical Engineering	Engineering Physics
	Physics
	Statistics

B. Current Resident Graduate Degree Programs

(At the College of William and Mary)	(At VARC)
Mathematics	Aerospace Engineering
Physics	Engineering Mechanics
Business Administration	Electrical Engineering
	Physics
	Radiobiology

C. Proposed Expansion of Programs

Chemistry
Chemical Engineering
Nuclear Engineering
Nuclear Physics
Biophysics
Astrophysics
Solid State Physics
Applied Mathematics

Admission and Degree Candidacy

Applicants for admission to the program at VARC must first be admitted to the graduate program of one of the cooperating universities. Approved applicants are then admitted to the program at VARC by the Langley Center's Graduate Studies Advisory Board.

Admission requirements of the cooperating institutions are stated in their respective catalogues, and generally require a bachelor's degree from an accredited college or university, above-average achievement as an undergraduate, and other appropriate evidence of ability to do graduate work. The Graduate Record Examination may also be required.

Each student must satisfy the degree requirements of the institution in which he is enrolled. Although particular requirements will vary from institution to institution, each school generally requires a separate application for degree candidacy (to be filed by a stated deadline), approval of the Department concerned, and an approved program of study and research. These and other details of degree requirements are stated in the respective catalogues of the cooperating institutions.

Enrollments

The combined demand for the VARC program represents an enrollment potential of 1,000 students in the immediate future, and a long-range potential of at least 2,000 students.

Additional Laboratories

To avoid wasteful proliferation of facilities, VARC promotes cooperative agreements with the Langley Research Center for the use of its laboratories and equipment in the VARC graduate programs. In addition, the College of William and Mary--just 15 miles away--has a $3 million physics laboratory and other major educational facilities available to VARC.

Many of the facilities at the Langley Research Center are being used for thesis work by graduate students including those associated with VARC. The major laboratories at Langley include transonic, supersonic, and hypersonic facilities, high-temperature materials and structures research laboratories, gas gynamics facilities, instrument research laboratories, and testing devices for space structures and vehicles.

Thesis research is also easily supported by auxiliary laboratories of Langley's major facilities. These contain a wide variety of research equipment for electronics, physics, structural testing, computing (both analog and digital), space mechanics, and aerodynamics.

The availability of such extensive facilities to a new graduate center of science and engineering is a notable asset. In the long run, it will also be possible for VARC to augment its own research facilities gradually, through the acquisition of surplus equipment, and through appropriations and Federal grants.

FLOW-THROUGH PROGRAMS

G.1 NBS RESEARCH ASSOCIATE PROGRAM

G.2 NIH LIMITED TENURE APPOINTMENT SYSTEMS

G.3 NASA SUMMER FACULTY FELLOWSHIP PROGRAMS

G.4 NASA-GODDARD INSTITUTE FOR SPACE STUDIES

NATIONAL BUREAU OF STANDARDS RESEARCH ASSOCIATE PROGRAM

What the Program Is

The Research Associate Program of the National Bureau of Standards makes it possible for qualified scientists and engineers from industrial corporations, technical trade associations, professional societies, and other Government agencies to work on a full-time basis for periods of six months to two years (or more) at the National Bureau of Standards on research programs of mutual interest to the sponsoring group and the National Bureau of Standards. Their salaries continue to be paid by their parent organizations.

Authority for the Program

The Bureau's Research Associate Plan rests upon two legal bases. A Joint Resolution of April 12, 1892, 27 Stat. 395, and an Act of March 3, 1901, 31 Stat. 1039 (20 U.S.C. 91), provide that facilities for study, research, and illustration in the government departments shall be afforded to scientific investigators and to duly qualified individuals, students, and graduates of institutions of learning in the several States and Territories, as well as in the District of Columbia, under such rules and restrictions as the heads of departments and bureaus may prescribe.

Operational Features of the Program

Establishing Research Associate Projects

Negotiations to establish a Research Associate project may be initiated informally with the appropriate NBS Division Chief by a representative of the organization desiring to sponsor the project. It is, of course, necessary to reach agreement regarding the character and scope of the project, the scale of effort to be applied, the facilities which the Bureau can provide, and the degree of supervision to be exercised by the Bureau. Such matters are usually arranged by conference and confirmed by an exchange of letters between the Director of the Bureau and the Administrative Head of the sponsoring organization, and by signing an appropriate Memorandum of Agreement which will describe the nature and scope of the project, the number of Research Associates to be designated, and the organizational unit of the Bureau which is to provide facilities.

Employment Conditions

1. Employees of the cooperating organization who are assigned to the project are called Research Associates. They are subject to terms of employment similar to those prevailing in Government employment, such as hours of work, conduct, and security. The sponsoring agency

will pay, in addition to the Research Associate's salary and travel expenses, the pro rata share of overhead costs after the first two years of sponsorship. Payment for overhead costs will be made to the Bureau, at the same rate as that applying to Bureau employees. Such costs will be billed to the agency by the Bureau at intervals determined by mutual agreement. Research Associates are not, for legal purposes, employees of the Bureau.

2. Each Research Associate and his sponsoring agency must agree to waive any liability on the part of the Government for personal injury, death, or property damage sustained by the Research Associate or by the sponsoring agency in connection with activities under the project.

3. The sponsoring agency will be held accountable for loss or damage to Government property (other than that resulting from normal wear and tear) occasioned by its Research Associate.

4. The results of work done by Research Associates must be available to the public under the same conditions that apply to the work of Bureau employees. Publications resulting from such work will conform to the publication policies of the Bureau.

5. Inventions resulting from participation in the Research Associate program which relate to the official functions of the participant, or in the making of which Government time, materials, or facilities are used, may be required to be assigned to the United States Government. The determination as to what patent rights, if any, are to be left to the inventor shall be made by the NBS Committee on Patents according to the criteria established for inventions of Government employees by Executive Order 10096 (dated January 23, 1950) as amended and any orders, rules, regulations or the like, issued thereunder.

The foregoing conditions do not imply that the Bureau may not assign personnel to, or pay the costs of, whatever work activities it deems appropriate to carry out as Bureau work, in conjunction with the activity of a Research Associate. In some cases, the Bureau may conduct work very closely related to, but not forming a part of, a cooperative project, and in other cases, a cooperative project may be coordinated with some existing work of the Bureau.

Reports, Publications and Patents

Research Associates may submit periodic progress reports to their supporting organizations through regular administrative channels. These reports shall also be available to the Bureau. Manuscripts prepared for publication will be handled within the Bureau in the same way as papers by members of the Bureau staff. These manuscripts may also be submitted to the supporting organizations for comment. In order to safeguard the public interest, however, the Bureau reserves the right to decide how and where results of a Research Associate's work shall be published. The Bureau's Journal of Research affords a suitable medium for publication of many of these papers, but publication in any medium desired by the supporting organization is ordinarily approved, provided that such publication makes the information available for general use. The original data and records of a Research Associate's investigation are Bureau property.

If the research leads to inventions or developments in which the government is entitled to protect its property rights by patent, the patent applications will be handled by government attorneys.

Present Status

At the beginning of 1965, thirty-four Research Associates were working at NBS, sponsored by eight trade associations who had maintained staffs here over a number of years. Since 1965, when the NBS Research Associate Program was given renewed emphasis, thirty new Research Associates have come to the Bureau from nineteen new sponsors. Fourteen of these new sponsors were industrial corporations (for example: IBM, Control Data Corporation, Proctor and Gamble Company, Aerojet General Corporation, American Cyanamid Company). Five trade associations also became new sponsors in this period. Six of the Research Associates from new sponsors added since 1965 have already returned to their sponsoring organizations after having completed their research projects at NBS.

Also since 1965, fourteen new Research Associates came to NBS from the original group of eight trade associations while twelve of the Research Associates from these sponsors completed their research projects at NBS.

There are now sixty Research Associates at NBS sponsored by twenty-two organizations (eleven private companies and eleven associations).

Future Plans

Further expansion of the program is planned through the efforts of the Office of Industrial Services, with participation by management and technical staff from all three NBS Institutes. The ultimate goal is to have about one Research Associate for every ten NBS professional staff members, or about 150 Research Associates.

THE USE OF LIMITED TENURE APPOINTMENT SYSTEMS AT THE NATIONAL INSTITUTES OF HEALTH

The strength of the NIH community depends upon the existence of a staff of mature scientific leaders whose accomplishments are recognized by their peers as superior. Such a staff of mature scientific leaders needs to engage actively with colleagues in other environments in searching for new or better answers to old problems. This is accomplished by participating in the activities of professional organizations and in many other ways.

The NIH community has found it profitable to use non-tenure appointment systems to attract scientists for short-run careers in biomedical research. In essence, these programs are part of the established educational process similar to basic preceptorial patterns followed in the academic world in which advanced post-doctoral work is regularly offered to increase the capabilities of the scientist as a generalist or a specialist through on-the-job experience. These patterns also serve as an exchange mechanism offering challenging opportunities for professional development which contribute materially to filling the national need for scientific manpower in biomedical research, both within and outside the public service. Most importantly they provide the organization an opportunity to examine a substantial number of promising young physicians and scientists from whom the most desirable may be selected to develop their careers and assume leadership roles in the organization.

I. Associate Training Programs in the Medical and Biological Sciences[1]

NIH's Associate Program had its beginning in 1953 when the Clinical Associate Program was initiated. The Research Associate and the Staff Associate were added in 1958 and 1964 respectively, and these three programs are now known conjunctively as the NIH Associate Program.

Under the Associate Program, medical students usually apply for positions as Associates in their senior years of medical school. If accepted, they receive commissions as reserve officers in the Commissioned Corps of the United States Public Health Service until they have completed their internships and all or part of their residencies. At that time, they are called to active duty and begin a two year period of duty as Associates in NIH's Intramural Research Program.

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[1] The Authority for Associate Training Programs is found in Section 203 of the Public Health Service Act (42 USC 204) establishing a Commissioned Corps of the PHS.

The three Associate Programs differ in the following manner:

A. Clinical Associates, who represent about 50% of the whole, participate in both clinical and laboratory research although Institute programs differ in the proportion of time devoted to laboratory and clinical responsibilities respectively. Ward activities are under the immediate supervision of competent clinical investigators, and include a wide variety of rounds, conferences, instructive exercises, and discharge essentially the same functions that residents perform in university hospitals.

B. The Research Associates Program, which accounts for approximately 20% of the Associate Program, was added to fill the expressed need for physicians with demonstrated potential for productive research; these Associates devote the larger portion of their time to laboratory research in the medical sciences. They have no clinical responsibilities. Each has a preceptor who trains him in research methodology and design, guides him in the conduct of specific undertakings and in the interpretation of results. Selected research problems enable the Research Associate to gain breadth and perspective, encounter a variety of laboratory problems, and learn many different approaches rather than become a specialist in one or two refined techniques. He also participates in a series of formal seminars and informal discussion groups designed in content and emphasis for prospective independent investigators.

C. Staff Associates (approximately 30% of the Associate Program) provide opportunities for those highly qualified candidates who can contribute significantly in areas which are not specifically designated in the Research or Clinical Associate categories. He may participate in various kinds of research, depending on the activities of the supervisor with whom he works. Research experience may be supplemented by formal evening study courses, as well as by attendance at lectures by guest speakers and a variety of regularly scheduled seminars.

NIH Associate Training Programs offer excellent experience and opportunities for productive research and clinical investigation. Consequently, there is a high level of competition among those who apply for positions as NIH Associates. For example, in 1966 NIH received 1,421 requests for applications to the NIH Associate Program. Of the 754 applicants who completed and returned these applications, 502 were selected for interview; 184 were finally appointed in the Associate Program, most of them representing the upper 10 percent of the graduating class.

The preceding paragraph brings into focus one of the problems faced by the NIH Associate Program. Selections must be made very early in the careers of potentially fine research scientists;

sometimes changes in interest occur. Program leaders must then make adjustments in assignments.

Since 1960, 849 Associates have come to NIH for training and experience. The majority have been Clinical Associates whose services have been indispensable in providing clinical care to research patients. Of those who finish their two year period of service as Associates, approximately 10 percent are asked to stay an additional year. Of these, about half are asked to become permanent members of NIH's research team. Those who have remained with NIH are now participating in or directing vital research programs.

Over five hundred Associates came to NIH prior to 1961 and have established career patterns subsequent to their service periods. Almost 70% of these have returned to responsible academic appointments in clinical medicine or laboratory research. Two-thirds of the group are working in states or regions different from those in which they received their medical degrees.

II. NIH Staff Fellowship Program[2]

The NIH Staff Fellowship Program is directly oriented towards providing young scientists with the opportunities for research and advanced training by working in close association with senior investigators of an interdisciplinary professional staff. Candidates selected for the program are those who have received a doctorate degree in medicine or one of the biomedical sciences within the past five years. The initial Fellowship stipend is determined by the candidate's educational and professional experience. Stipends generally correspond to the GS schedules appropriate for the discipline with the exact stipend fixed within a low-high range to recognize varying degrees of professional accomplishments. All appointments count against employment ceilings. As the Fellow progresses in the program and demonstrates professional competence in his field, further increases in the stipend are authorized. Upon completion of the Fellowship, the Staff Fellow is released to accept a career of his choosing--either in the public service or elsewhere in university, private, or other centers for biomedical research.

The program is especially designed to overcome the barriers which have traditionally handicapped the government service in attracting promising young scientists under civil service appointment procedures which are control-and-procedure oriented. The concept of a two-three year post-doctoral honorific fellowship, with no commitment to permanent employment, is one which makes it especially appealing to the young scientist, particularly for those who may be prejudiced against regular government employment because of the negative image which is frequently associated with career appointments in the Federal service.

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[2] The Authority for the Staff Fellowship & Visiting Programs is derived from Section 207(F&G) of the PHS Act and Part 61 of the PHS Regulations (42 USC 216).

The scientist is able to enter the government under non-competitive procedures without any obligation to accept a career appointment; his career development and professional competence is substantially strengthened by working with established leaders in the NIH laboratories and clinics; upon completion of his Fellowship, if he is not interested or selected for a career appointment in the government service, he is free to move into another sector of the biomedical research community without any stigma being attached to his decision.

The program also directly benefits the NIH as the employing agency in that (1) it enhances the prestige of government employment by providing short term career opportunities under conditions similar to the special appointment and fellowships available in universities; (2) it provides an extended observational period, in contrast to the typical one year trial period under career appointments, to evaluate sensitively the scientist's true potential as an investigator; and (3) it provides the NIH with a continuing pool from which to select investigators for career appointments to positions offering long term opportunities for growth and productive research. Those who demonstrate superior potential during the first two years of their fellowship, may be awarded a one year extension of their fellowship, during which time they are considered for a permanent position on the NIH staff.

The program, conceived in 1961, became operational in late 1962. Since its inception, some 90 fellowships have been awarded. About 35 of the scientists selected have completed their fellowships; 13 were retained for career appointments at the NIH and 22 left NIH to accept positions in universities and other research centers. The program is thus filling the objectives established by providing a continuing turnover and exchange of young scientists between the NIH and other centers for medical research. Such an exchange is mutually beneficial to the individual and the institutions involved.

III. The NIH Visiting Program[3]

The NIH initiated a Visiting Program in 1950 to facilitate the appointment of foreign-born scientists, associates and fellows in the NIH research programs. The basic intent of the program is to create the environment which encourages the exchange of concepts and/or research approaches, thinking and philosophy between our own scientists and those of other nations. On rare occasions, United States scientists who are on sabbaticals accept short-term assignments under the Visiting Program. For the most part, however, visitors are foreign nationals.

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[3] See footnote 2 on p. 3.

Three levels of competence are recognized in the Visiting Program:

A. Visiting Scientists[4]--those appointed as Visiting Scientists (27 percent of these in the Visiting Program) have advanced post-doctoral training, are mature scientists, and have made substantial contributions in their fields of interest. Salaries are based on the quality of their research experience in their disciplines, and in general parallel the rates established for positions at GS-12 through GS-15, rarely higher.

B. Visiting Associates[4]--those appointed as Visiting Associates (34 percent) have at least three years post graduate training and have demonstrated promise for making effective contributions in their fields of interest. Salaries equate those established for grades GS-9 to GS-11 under the Classification Act.

C. Visiting Fellows--those appointed at this level (39 percent) have the equivalent of a Ph.D. degree with less than three years of post-doctoral education. Visiting Fellow appointments, unlike those for Scientists and Associates, are for training purposes, where the principal intent is to provide educational opportunities commensurate with the responsibility usually assumed by university faculty members for their post-doctoral fellows. Visiting Fellows, unlike Visiting Scientists and Visiting Associates, are not chargeable against personnel ceilings. Salaries are in the form of stipends and range from $6,000-$7,000 per year with additional allowances for dependents. The plans for training are made in a manner which is mutually satisfactory to the Fellow, his Sponsor, and the Scientific Director of the Institute or Division.

Appointments under the visiting program are limited to one year. Visiting Scientists and Associates may have their appointments extended for an additional year when there is a clear demonstration that there are direct benefits to both the NIH and visitors. These appointments are excepted from the classified and competitive Civil Service.

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[4] The number of Visiting Scientists and Associates who may be appointed is administratively limited to such number which will not exceed 10 percent of the total NIH professional staff. However, in practice, appointments made during any fiscal year fall well below this guideline.

During the past five years, more than 950 appointments have been made from some 50 different countries. The great majority of those receiving appointments have returned to positions in their own countries. Very few have remained at NIH to participate in or to lead research projects.

The mutual benefits which accrue to both the NIH and to the nations from which the visitors come are principally those which result in the dissemination of new knowledge resulting from discussion, new approaches and airing differences in points of view. These discussions and studies lead to a more penetrating examination of specific issues and a more complete understanding of the problem under study.

National Institutes of Health

Appointments in the Visiting Program 1961-1965

Country	1961	1962	1963	1964	1965	Total No. Appointments
Argentina	1	1	1	3	3	9
Australia	5	6	4	6	8	29
Austria	4	2	1	1	-	8
Belgium	1	1	3	3	2	10
Brazil	3	5	4	1	1	14
Canada	8	8	7	7	6	36
Chile	1	1	1	2	1	6
China	3	4	3	3	4	17
Colombia	1	1	-	-	-	2
Cuba	-	1	1	1	-	3
Czechoslovakia	-	-	-	1	3	4
Denmark	1	2	2	1	-	6
Egypt	-	3	2	-	-	5
England	20	23	22	25	22	112
Finland	1	4	4	1	2	12
France	2	4	6	5	5	22
Germany	9	9	6	4	8	36
Greece	1	1	2	2	1	7
Holland	3	4	4	5	3	19
Hungary	1	1	1	2	2	7
India	16	22	17	15	7	77
Iran	1	1	-	-	-	2
Iraq	-	-	-	-	1	1
Ireland	1	-	-	1	1	3
Israel	8	10	7	6	11	42
Italy	9	14	13	14	11	61
Jamaica	1	-	-	-	-	1
Japan	36	46	56	44	29	211
Korea	1	1	2	3	1	8
Latvia	1	1	1	1	1	5
Lebanon	2	2	1	1	1	7
Mexico	-	-	1	1	1	3
New Zealand	1	1	1	1	1	5
Nigeria	-	-	-	1	1	2
No. Wales	-	-	1	1	1	3
Norway	1	1	-	-	-	2
Pakistan	2	3	3	2	1	11
Philippines	1	-	2	1	1	5

National Institutes of Health

Appointments in the Visiting Program 1961 - 1965 Cont'd

Country	1961	1962	1963	1964	1965	Total No. Appoint-ments
Poland	-	2	3	2	2	9
Portugal	-	-	1	1	1	3
Scotland	1	2	4	3	2	12
So. Africa	3	3	2	2	1	11
Spain	2	1	2	3	3	11
Sweden	6	5	5	6	7	29
Switzerland	8	6	7	3	4	28
Turkey	2	3	1	-	1	7
Uruguay	-	3	-	-	-	3
Yugoslavia	1	3	1	1	1	7
Stateless	-	-	-	-	1	1
Total	169	211	205	186	163	934
USA	12	12	5	2	1	32
TOTAL	181	223	210	188	164	966

NASA SUMMER FACULTY FELLOWSHIP PROGRAMS

NASA, in conjunction with cooperating universities, conducts ten-week summer fellowships for selected engineering and science teachers.

One program, offered in conjunction with the American Society for Engineering Education, provides for approximately 150 new fellowships, available for cooperative research and study at Manned Spacecraft Center, Goddard, Marshall, Ames, Langley, and Lewis. The objectives are (1) to further the professional knowledge of qualified engineering and science teachers; (2) to stimulate an exchange of ideas between participants and NASA; and (3) to enrich and refresh the research and teaching activities of participants' institutions. The program is particularly directed toward engineering and science educators in the early stages of their careers. Participants may be invited to return for a second year.

The programs vary from center to center, but all involve a combination of research and study, with the preponderance of time devoted to research. The research is normally conducted on projects related to the program of the center; lab equipment and experimental facilities are made available as required. The study is usually a combination of formal lectures or seminars, discussions, workshops, and similar activities.

Qualifications: Applicants should be instructors, professors or research staff members of colleges or universities, preferably with two or more years of teaching experience. U.S. citizenship is required. Programs are focused on subject-matter research and educational activities related to the work of the particular center involved.

Fellowship stipends are intended to meet the salary of the participant but do not exceed $225 per week for first year Fellows. A travel allowance is also paid.

The other program provides approximately 70 fellowships in engineering systems design to qualified engineering and science faculty members, in programs of summer study undertaken by several universities in cooperation with three NASA centers (Ames, Marshall, Manned Spacecraft Center). Fellows come to universities located adjacent to the NASA centers to participate as members of multidisciplinary design teams. Each group selects and designs a complex space system, such as an unmanned planetary reconnaissance vehicle, a manned spacecraft, or an applications satellite system. The Fellows are directly associated with the on-going activities of the space program with the attendant confrontation with the most modern systems design problems.

The principal objective of the program is to allow the participating Fellows to increase their competence and to develop concepts which will enable them to organize multidisciplinary engineering systems design courses at their home institutions. Such system design concepts have proven to be highly effective in stimulating student innovation, and in teaching the application of engineering theories to actual engineering problems. The program also improves communication between engineers and scientists in different specialties and helps illustrate the importance of such communication, aides in teaching methods of parametric evaluation of complex system alternatives, and introduces the students to the potentialities and challenges of the United States space program.

Stipends and qualifications similar to those in the first program apply, although in this program preference is given to faculty who apply as a team representing at least two different areas of engineering or science from the same institution, and whose administration is interested in enhancing the application of systems design at their university after the completion of the fellowship program.

NASA-GODDARD INSTITUTE FOR SPACE STUDIES

Located in New York City, the Goddard Institute for Space Studies provides resident research associateships to qualified post doctoral and senior post doctoral candidates under a program administered by the National Research Council.

The Associates are selected by an evaluation board appointed by the NRC; positions are open to both U.S. citizens and to foreign nationals. The purpose is to provide to investigators of unusual ability and promise an opportunity for theoretical research, which plays a significant role in the space program.

Applicants are accepted at any time. Regular Post Doctoral Resident Research Associates are appointed for one year with provision for a vacation period. The tenure for the Senior Post Doctoral Resident Research Associates is one year; however, tenures of other lengths may be considered at the discretion of the Board. Applications for renewals are also considered. No commitment on the part of either the Research Associate or the Institute with regard to later employment is implied by the acceptance of an award. Applicants must produce evidence of training equivalent to that represented by the PhD or ScD degree, or must have completed the requirements for one of the above degrees at the time of entering upon the associateship. Candidates must also have demonstrated superior ability for creative research. The regular associateship is normally open to individuals at the immediate post doctoral level, ordinarily not more than four years beyond the PhD. The Senior Research Associateships are open to well-established investigators normally at least five years beyond the doctorate.

The stipend for the regular Post Doctoral Resident Research Associate is normally at the rate of $11,500 per year. The stipend for investigators with suitable research experience beyond the doctorate is set by the Board. The stipend for the senior Post Doctoral Resident Research Associate is adjusted in terms of the individual's own salary together with a proper dislocation allowance. For a foreign award, the basis would be a level of stipend which would match the salary of the individual's American counterpart. An appropriate travel grant is determined by the Board for each Associate. All stipends are subject to income tax. The Research Associates are paid directly by NAS; they are not officially employees of NASA. The costs of the program, including the stipends and administrative expenses, are funded by a NASA grant.

The Institute conducts research in astrophysics and planetary physics, with emphasis on nucleo-synthesis, stellar structure and evolution, galactic structure, and problems relating to the origin of the solar system and the evolution of planetary bodies and their atmospheres. An observational program in infrared and submillimeter astronomy is in progress. The program in planetary atmospheres includes basic studies in convection and radioactive transfer, and studies of the general circulation and heat balance of the terrestrial atmosphere in conjunction with analyses of meteorological satellite data. The Institute program is carried out in close cooperation with Columbia University and other centers of research in the New York City area.

Each Research Associate is expected to devote his efforts entirely to his research program. A Research Associate may not receive aid from another appointment, fellowship, scholarship or similar grant during the term of his appointment. However, with the approval of the research advisor, a limited amount of advanced teaching may be done provided there is no conflict with the responsibilities and the regular hours as a full-time Research Associate, and provided that the teaching is a vital aspect of the space science program of the Institute.

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THE DEPUTY SECRETARY OF DEFENSE
Washington, D. C.

MAY 13, 1964

MEMORANDUM FOR The Secretaries of the Military Departments
The Assistant Secretary of Defense (Comptroller)
The Assistant Secretary of Defense (Manpower)
The Director, Defense Atomic Support Agency
The Director, Defense Communications Agency
The Director, Defense Intelligence Agency
The Director, Defense Supply Agency
The Director, National Security Agency

SUBJECT: Establishment of a Pool of Spaces and Funds for Long-Term Civilian Training Program

References: (a) DoD Instruction 1430.5, "Civilian Employee Training Policies and Standards"
(b) DoD Instruction 1430.1, "Civilian Career Development"
(c) DoD Instruction 1430.8, "Management Education and Training of Civilian Employees of the Department of Defense"

A large percentage of the training and development needs of civilian employees within the Department of Defense can be fulfilled by training programs of relatively short duration and of nominal cost. In such instances, the trainees are not away from their jobs for a sufficient length of time normally to create a staffing problem for the employing activities. However, if the Department is to keep abreast of management, technical, and scientific advancements, both within and outside the Federal Government, increasing attention must be given to providing selected employees with appropriate developmental opportunities beyond the customary programs of short duration. It is in these instances of long-term education and training (in excess of 120 days), where the expenses may be appreciable and where the trainee's services are lost to the organization for a considerable period of time that provision normally must be made for needed staffing support necessary for achievement of organizational objectives during the absence of employees in such training. To date, very limited use has been made of this technique for improving the capabilities of the civilian work force.

APPENDIX H

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Each military department, Defense agency and the Office of the Secretary of Defense will initiate action to set aside a special pool of spaces and funds to support projected requirements for long-term employee education and training requirements to meet identified needs for development of technical and managerial skills. This pool of spaces and funds, specifically earmarked for long-term education and training, should be established at the level of the Secretary or the Director of the respective Defense component concerned. Allocation of spaces and funds from the central pool of each DoD component can be made to major commands for administration at that level only when a specific plan for their use has been approved in advance by the Secretary of a military department or Director of a Defense agency. Under this arrangement, spaces and funds for long-term training can be more efficiently utilized and organizations operating at lower levels will not be forced to divert current resources furnished for direct support of mission to meet longer range requirements of this nature.

The central pool of funds established each fiscal year to cover tuition, salary and related expenses will contain funds from RDT&E, O&M, and other appropriation accounts for payment of salary and related expenses in proportion to the estimated requirements for expenditures for long-term training of personnel whose salaries are paid from these respective accounts. The central pool account (RDT&E, O&M, etc.) from which an employee is paid while in training will be the same type appropriation account as is used to pay his salary on the job. Employees when assigned to long-term training with the funds and ceilings made available from the central fund will continue to be employees of the installation which arranged for their participation in the training and will, as a minimum, be entitled to return to their old positions upon completion of the training.

In order that the initiation of this important program will not be unduly delayed, an initial central pool of spaces and funds, based on known current requirements, will be established for Fiscal Year 1965. This can be accomplished by reprogramming existing spaces and funds presently being used by the military departments, Defense agencies and the Office of the Secretary of Defense for long-term education and training and, to the extent possible, by the assignment of additional resources needed to create an effective program.

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It is requested that each addressee survey his Fiscal Year 1966 thru 1969 needs for spaces and funds for long-term (in excess of 120 days) management and technical education and training of civilian employees and, to the degree that space and fund requirements cannot be met within the presently approved Five Year Force Structure and Financial Plan, a Program Change Proposal to cover the requirements should be submitted.

To realize the objectives of references (a), (b) and (c) and especially paragraph IV.B of reference (a), each DoD component will furnish the Assistant Secretary of Defense (Manpower) by August 16, 1964: (a) information as to the central pool established for FY 1965 and the results of survey for FY 1966 needs for spaces and funds, (b) separate estimates of space and fund requirements for FY 1967, 1968 and FY 1969 and (c) implementing regulations for centrally administered pool of funds and spaces.

The implementing regulations should give particular attention to provisions: (1) for insuring the establishment of a positive plan for the most effective use of each employee upon his return from training, (2) for the preparation of such plans in advance of the employee's assignment to long-term education or training, (3) for the plans to be monitored by a higher headquarters to make certain that shifts in installation personnel or other changes do not adversely affect the employee during his absence for training and that management's objectives for the training are being achieved as planned.

/s/ Cyrus Vance

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MANPOWER SPACE REQUIREMENT
FOR LONG-TERM CIVILIAN EDUCATION AND TRAINING
Fiscal Years 1969 - 1973

Command	FY 69	FY 70	FY 71	FY 72	FY 73
AFLC	21	23	19	19	19
ACIC	20	17	16	16	16
AFSC	117	123	127	133	133
OAR	10	10	10	10	10
AFESSC	4	4	3	4	4
ATC	5	6	6	6	6
AFAFC	1	1	1	1	1
ADC	2	2	2	2	2
Total	180	186	184	191	191

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